

MAIZE AMONG THE HILL PEOPLES OF ASSAM

C. R. STONOR AND EDGAR ANDERSON

INTRODUCTION

Maize is widely grown in the Orient and is used there for a variety of purposes. Authorities once quite commonly believed that it originated there, but the demonstration that it was almost universal in the New World in pre-Columbian times made an American origin seem most likely. From a meticulous investigation of the historical evidence Laufer (1907) concluded that maize did not reach the Orient until post-Columbian times, and Merrill (1941, 1946) produced convincing evidence that maize and other New World crops had been carried to the Philippines at an early date by the Spaniards and had been widely spread on the continent of Asia. The subject seemed closed and the lack of any evidence for pre-Columbian maize in the Orient became one of the most powerful arguments against any effective trans-Pacific communication in pre-Columbian times.

Several years ago the two authors of this paper came independently to the conclusion that the subject needed to be reopened and examined on its own merits. The senior author, working in the mountains of Assam, found distinctive varieties of maize widely cultivated by the primitive Nagas. The ethnological and linguistic evidence suggested that these varieties had been in that area a very long time and most probably must have arrived there in pre-Columbian times. The junior author, having made a beginning at distinguishing between the various races of *Zea Mays* (1942, 1943, 1946), found that the history of maize in the Orient was apparently complex. There was abundant evidence that Merrill was right and that varieties quite similar to those grown in the Caribbean had been brought to the Philippines and Guam by the Spaniards and have since that time been widely spread and extensively grown in the Orient. However, the popcorns, green corns (i.e. those used as a fresh vegetable) and brewing corns did not fit into this picture at all. Almost without exception they are grown by primitive peoples. Their distribution is notoriously spotty and is mostly confined to various ethnological back corners. The Oriental popcorns, furthermore, are not at all like the popcorns of Central America. They are on the whole similar to varieties of maize grown in Peru and Chile in early prehistoric times. As soon as one was able to distinguish effectively between different races of maize, Laufer's conclusions were no longer valid. His evidence can now only be interpreted as showing that maize in the Orient has had a long and complicated history. At an early date the popcorns, green corns, waxy corns, etc., spread widely in the Orient. At a much later date different varieties of field maize were introduced by the Spaniards, and over wide areas are the only type being grown today.

Through the good offices of Dr. W. B. Turrill and Mr. C. E. Hubbard of the Royal Botanic Gardens at Kew, the two authors were put in touch with each other

and since that time have worked together as closely as the distances involved and disturbed world conditions would permit. The collections of native kinds made by Stonor have been grown, pressed, measured, and photographed in Assam. Samples of the same varieties were grown by Anderson at the California Institute of Technology (through the courtesy of Dr. E. G. Anderson) and were pressed, measured and photographed. Pachytene smears were made of each culture with the assistance of Dr. A. E. Longley and Dr. W. L. Brown.

In the following paper the evidence relating to these Assamese varieties, evidence ethnological, linguistic, distributional, morphological, and cytological, is set out as objectively as possible. Part I was written by Stonor, Part II by Anderson. To the authors the conclusion seems inescapable, that there are at least two races of maize in Asia and that one of these must have crossed the Pacific in pre-Columbian time. The direction (or directions) in which it travelled, however, is still uncertain. This new evidence, in other words, tells us little or nothing about the origin of maize. It does, however, enlarge the possibilities which must be considered in any serious investigation of that fascinating problem.

PART I

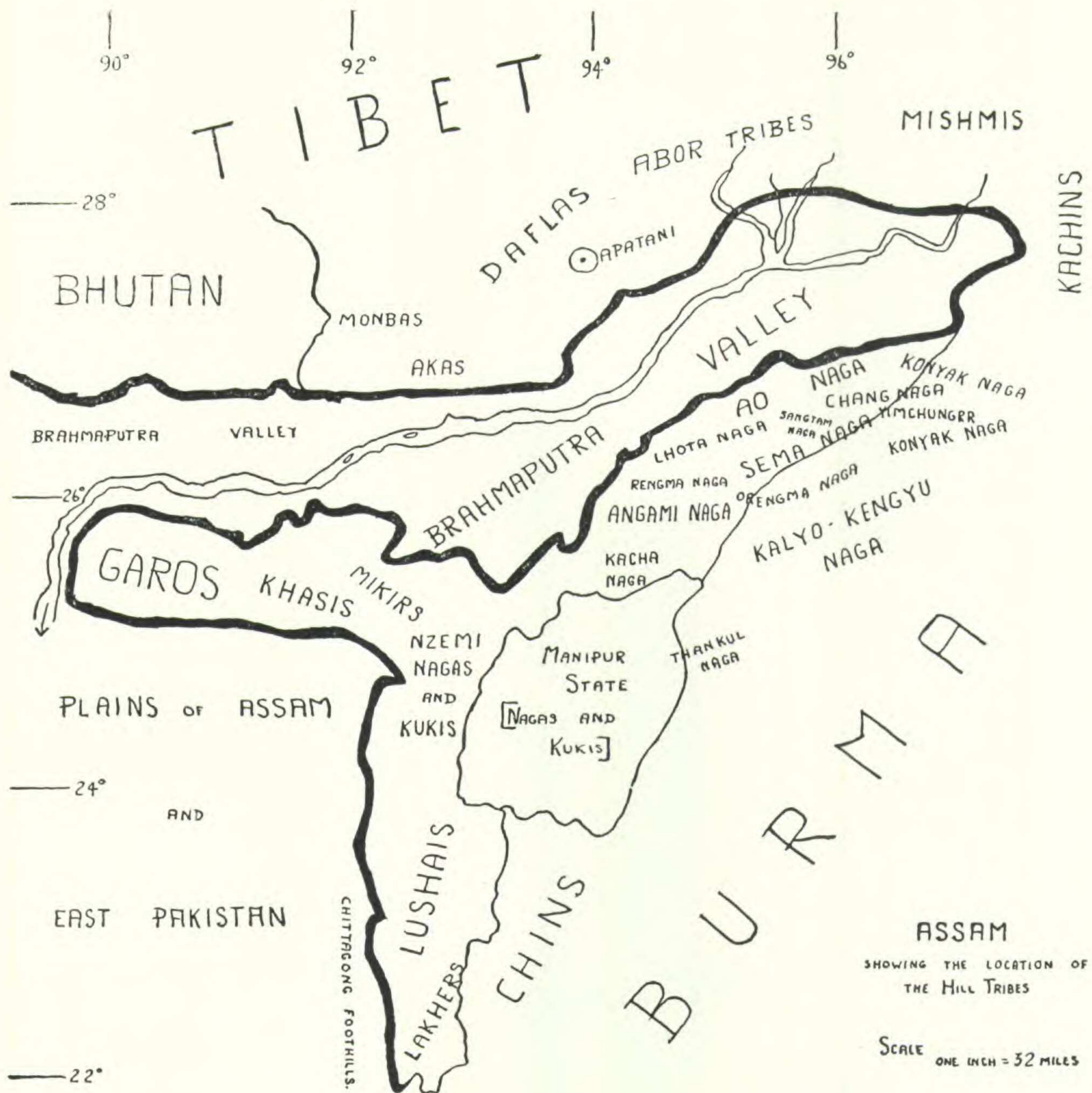
C. R. STONOR

Before detailing the uses of maize among the hill tribes of Assam, it is necessary to give a very short general account of the tribes themselves and particularly from the angle of their probable origins and directions of migration.

Taking first the tribes of the Assam-Burma border:

1. NAGA TRIBES:—The Naga Hills are inhabited by at least ten tribes, who, although they possess a number of features of culture indicative of common elements in their origin, show many sharp differences in culture, language, traditions, temperament, and physical characters. The Naga tribes are, in fact, more correctly described as the tribes inhabiting the Naga Hills. It is well established that they have elements in their culture complexes indicating wide diversity of origin. There are well-established links with Indonesia, Burma (including the Burma-China border), the Pacific and India. The dominant element today is widely different from any of the main cultures of India, and far more bound up with tribal peoples of Indonesia and southeastern Asia (including Burma). It is certain that there has been continuity of settlement in the Naga Hills for many centuries or millenia. Stone celts are commonly found in the hills, although no tribe today has any tradition of ever having used them. There has probably been a good deal of movement to and from the hills from the Brahmaputra Valley.

2. LUSHAI-CHIN-KUKI TRIBES:—These tribes have limited affinities with the Nagas; and their immediate origin seems to be from hill regions of Burma, where they are closely related to the Karens. There are also undoubted kinships with Indonesia. They are pronouncedly Mongolian and have little or nothing in common with any part of India.



3. MANIPUR STATE:—Manipur State is inhabited by a hill population of mixed Kuki and Naga elements, and the big population of the great valley of Manipur is partly derived from these (and particularly the Nagas), and partly from an ancient Mongolian element of uncertain origin.

Taking the tribes of the ranges running east and west and bordering the Brahmaputra Valley on the South in Assam:

1. MIKIR TRIBES:—The Mikir Hills are inhabited by mixed tribes of uncertain origin. There are probably links with both Kukis and Nagas and with the peoples on all sides of them.

2. **KHASI TRIBES:**—These are classed with the Mon-Khmer group, and their main origin is generally regarded as being the region of Indo-China. It is quite possible that there is an ancient strain in the population akin to the aboriginal stocks of peninsular India and originating from further West. The Khasis are widely different in many respects from the other tribes of Assam.

3. **GARO TRIBES:**—The Garo tribes have definite affinities with elements among the Nagas and with tribal peoples of the Plains of Assam. There is also some indication of links with Bhutan, and there may well be kinship with parts of India to the West.

Turning to the tribes of the Assam Himalayas lying north of the Brahamaputra:

4. **MISHMI, ABOR, APA TANI, DAFLA AKA, MONBA and LAMAI:**—The tribes of the Assam Himalayas, divided extremely roughly into Mishmi, Abor, Dafla, Apa Tani, Aka, Monba and Lamai as the main groups, have been very little studied. There has undoubtedly been much migration from the east and I am of the opinion that a big element in the population is akin to the Kachin peoples of northern Burma. There are marked cultural similarities with the Naga tribes, mainly among the Abors. There has been infiltration down river valleys from Tibet and very possibly in the reverse direction into the hills from the Brahamaputra Valley. The Monbas, a small tribe living near the Bhutan border, may have originated from that state.

Even these meagre notes show the hill tribes of Assam to be as mixed a population as can well be imagined, who are linked with literally every part of Asia. Prehistoric (?) stone celts are found throughout the hills, indicating very ancient population. These celts are recorded in the literature from all hill areas south of the Brahamaputra, and I have celts in my possession from the Abor and Dafla Hills of the Outer Himalayas.

Except for the Angami Nagas, the Apa Tanis and the Monbas, and to some extent the Khasis, the basis of subsistence economy is still dry cultivation, carried out by cutting and burning the forest and raising crops for one or more seasons in the area so cleared. The main subsistence crop in the majority of cases is rice, but millets, Job's Tears, sorghum, maize, are all important and are grown in varying amounts by nearly all tribes. In a few instances, one or other of these cereals is as important as rice, as, for example, among the Abor tribes, who grow rice and Job's Tears in almost equal amounts, or the Chin tribes of Burma and the Monba tribe of the Bhutan Border, who grow more maize than they do rice. It seems probable that the complex of Job's Tears-millets-maize preceded rice as the main food supply of many tribes.

In general, the tribal peoples of the Assam mountain tracts live in the so-called Neolithic stage of culture. The community is a self-contained one, growing its own food, weaving its own cloth, regulating its own affairs by tribal law. There is no writing, and the religion is animistic. The level of culture is very similar to the tribes of Borneo, the mountain tribes of the Philippines, and some at least of

the South American Indians. In the Naga, Lushai, Khasi, Mikir and Garo hills there has been missionary activity for some decades, and the tribes have been administered for the same period, so that far-reaching changes have set in. This is not, however, of consequence for my present purpose, the more so since administration has done remarkably little to change or to develop the economic life. In the Himalayan tracts north of the Brahmaputra, administration has only been started since the end of the War. Missions are banned from entry, and large tracts are still unexplored.

DETAILS OF VARIETIES, CULTIVATION, USE, ETC., OF MAIZE AMONG THE
HILL TRIBES OF ASSAM

The notes which follow are all based on information obtained at first hand in the field, either by direct observation or questioning members of the tribes concerned, or more usually by a combination of both. Where I have had to rely on the work of others, or have not visited an area, I have drawn attention to the fact.

1. ANGAMI NAGAS:—

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Varieties grown: Nos. 5–18, particularly the larger flint types.

Ecology and technique: The Angami Tribe lives in hills from 2500 to over 6000 feet in altitude. The great bulk of the tribe lives above the 4000 feet level and in a sub-temperate climate. Maize is universally grown, and the larger flint types predominate. The Angamis have a remarkable system of irrigated rice-cultivation, and only a small proportion of their crops is grown on dry fields. Maize is grown mixed either with millet and Job's-tears or else as a pure crop, usually in small plots in the immediate vicinity of the village. Sowing is by dibbling.

Uses: Their irrigated rice-cultivation leaves the tribe well provided for. Maize, along with millets and Job's-tears, is important for human consumption mainly among poorer people who are short of rice fields. It is, together with subsidiary crops (notably millets), a catch-crop to "fill up corners" before the rice is harvested. It is eaten fresh, either boiled or slightly roasted, and is largely consumed by children. The main use among this tribe, in years of good harvests at least, is for *pig feed*, the grain being parboiled and roughly mashed. It is only so used when actually in season, and is not stored for feeding the pigs. Small quantities of the popcorn types are stored for popping, but this is not important. It is used occasionally as an ingredient in beer, along with other cereals.

Storage: The ears are hung up on the rafters of the dwelling house for next season's seed.

Folklore, traditions, etc.: The Angamis I have talked to simply state that they have grown maize from time immemorial. The tribal name of corn is *Tsüke*.

2. LHOTA NAGAS:—

Varieties grown: The varieties grown in the village of Yimbang at elevations of less than 2000 feet in the sub-tropical lower ranges of the area are:

1. *Tchetum-sopfu* (Serial L. 1), meaning "Small late," regarded as an indigenous variety.

2. *Moro* (Serial L. 2), meaning "Quick or early eating," regarded as indigenous.
3. *Aorr-chemyang* (Serial No. 6 of first consignment), meaning "Ao Nagas blood." This refers to traditional origin from the neighbouring Nagas, the term blood having reference both to the small red grains, and to the former enmity between Lhotas and Ao's.
4. *Konoma-tsunghundbro* (Serial No. 8 of first consignment), meaning "Konoma Maize," the name Konoma being that of a large Angami Naga village to the south of the Lhota country, and indicating that it probably derived from there. A very similar type is known as *Wokotsu*, because it was first got by Yimbang from a Lhota village of that name.
5. *Epuk* (Serial No. 12 of the first consignment), meaning "Bursting," as it is only grown for popcorn.
6. *Kor-chak*, meaning "Horse-Food." This variety, a coarse flint maize grown in many parts of India, was obtained within living memory from Nepalese immigrants into this region. The name is derived from the custom of the Nepalese of keeping ponies.

The main varieties grown in the village of Yekhum, in the higher areas of the Lhota country and almost within sight of Yimbang, where conditions are between sub-tropical and sub-temperate and the altitude about 4,000 feet, are only two: (1) *Korchak* and (2) *Konoma-tsunghundbro*. Both are said to be of fairly recent introduction, and supplanted other types. Other types may be grown in small amounts.

Ecology and technique: A great part of the Lhota Naga country is sub-tropical, and there are few villages situated over 4,000 feet. The types grown are naturally those most suited to this climate. Maize is grown as a mixed crop among the rice and subsidiary cereals. It is commonly sown in rows along the edges of field paths or inter-field boundaries. The seed is dibbled, and the sowing season is March-April, while the harvest is from June to early August.

Uses: Maize is not a very important crop among the Lhota Nagas and, as among the Angamis, it is grown wholly as a catch-crop, utilized before the rice harvest is in. But it is grown entirely for human consumption, and except for the popcorn *Epuk* variety, it is entirely consumed as it ripens. A little is used now and again for beer-making. The reasons for growing the different types is gone into in more detail below.

Storage: The ears for next season's seed are simply hung up on the rafters of the dwelling house.

Traditions, folklore, etc.: The general word for maize is *Tsunghundbro*, which means "something obtained from the Angami Nagas," and I have been told of a vague tradition that the Lhotas first got maize from their Angami neighbours. On the other hand, the variety *Tchetum-sopfu*, listed above, is regarded by the Lhotas as their own maize and does not seem to be grown by the Angamis.

The Lhotas have been in their present country for a matter of centuries. They state that they have had maize from time immemorial.

3. AO NAGAS:—

Varieties grown: Some or all of Serial Nos. 5–18.

Ecology and technique: Closely parallels that of the Lhota tribe.

Uses: As among the Lhotas, it is entirely for human consumption.

Storage: As for the Lhotas.

Traditions, folklore, etc.: The Ao Nagas have a tradition that they have always grown maize among their field crops. The usual name for maize is *Mentia*, for which I can get no translation. A small group of villages which have a different language know it as *Achang-Tangba*, which means "bearing rice already husked." A curious local name has been recorded by J. P. Mills ("The Ao Nagas," 1926. p. 125, footnote) as used in the Ao village of Changtongia: *Moya zungkhum*, meaning "Sema Naga Lentils."

4. SEMA NAGAS:—

Varieties grown: Some or all of Nos. 5–18.

Ecology, technique, etc.: Very much as for the Lhotas and Ao's, except that maize is a much more important crop and is planted thicker on the ground. Sown during March–April, and harvested in June–August.

Uses: Is of considerable importance for human consumption, both fresh on the ear and (to a lesser extent) stored and pounded to mix with rice. It is also used to make several types of strong beer, again to a greater extent than among other Naga tribes. My information from the Sema area is scanty. However, the importance of maize is very likely linked with the shortage of land for cultivation and the large population of poor people, so that the staple food of rice is apt to be finished well before the next harvest. Catch-crops are consequently of much importance, and rice insufficient for beer-making.

Traditions, folklore, etc.: The Semas regard maize as an ancient crop. The name for it is *Kolakithi*. This is usually translated as "Foreigner's Job's-tears," and some Europeans have assumed without evidence "Foreigners" to mean the British and that maize was introduced into the Naga Hills by the British (!). Apart from this, I have been given another meaning for the word by a Sema Naga: "Grain that is eaten by plucking singly." Another word is *Amebukethi*, meaning "a grain ripe and eaten before the rice."

5. CHANG NAGAS:—

Varieties grown: Some of Nos. 5–18.

Ecology, technique, etc.: As for other Naga tribes. Most of the Chang Naga country is high and cold with sub-temperate climate, and the larger coarser flint types predominate. A small popcorn (Serial No. 12) is grown, and the African dent maize is also cultivated.

Uses: Except in a few low-elevation villages, the Chang Nagas even today depend largely for their subsistence on millets, Job's-tears, maize and taro, rather than rice. Maize is thus an important crop. It is, however, largely a catch-crop, eaten fresh, but appreciable quantities are stored and are mixed with other cereals for food during the cold weather. It is used preferably in making beer, and to a small extent for popcorn. Some, particularly in seasons of good harvest, is fed to the pigs.

Storage: In round baskets, stripped from the cob, in separate granaries.

Traditions, folklore, etc.: The Chang name for Maize is *Hangi*, for which I can get no translation. It is certain from their traditions and recent history that the Chang Nagas have been pushing west from the Burma side for some generations, and they themselves claim that at least a large element in their composition came from further east. Their economy is as noted, still based very much on Job's-Tears, millets, and maize. This is partly due to their living largely in high altitudes and possessing no suitable type of rice for the climate; but I have several times been informed by Changs that it is only since they have had contact with the more westerly Naga Tribes that they have taken to rice at all; and rice is widely recognized as being a more recent crop than the other cereals, maize not excluded. Among this tribe each major crop has its own minor tutelary deity, maize among the rest. The African dent maize is known as *Bilati Hangi*, meaning "English Maize."

6. YIMCHUNGRR, KONYAK and KALYO-KENGYU NAGAS:—

I have very little information from any of these tribes. Maize is grown in varying amounts by them all. It is said to be an important crop among the Kalyo-Kengyu, but not very much grown among the Konyak Nagas, who are among the most ancient stock in these hills. I have visited the extreme northeast area of the Konyak country, where a poor type of one of the larger-grained flint maizes is grown in small quantities. I was told that the people were not keen on it as it attracted bears to the fields. The Konyak name for maize is *Tongi*.

7. KACHA NAGAS and NZEMI NAGAS:—

These two closely allied groups inhabit the southern Naga Hills. I have been there once and can confirm that maize is grown in the fields along with other cereals, and my original stock of small-grained types came from this area. The area varies a great deal in elevation (from 1,000 to 7,000 feet) and most or all of Nos. 5-18 are grown.

I have a rather vague report from a Government subordinate concerning a branch of the tribe living in the hotter areas, about 3,000 feet, that three main types are recognized: (1) *Imbaume mei Mitak*, early; (2) *Lingtak*, second to ripen; (3) *Lingtak tiingne*, late. The first two are said to be the most widely grown.

The Kacha Nagas have a tradition that the tribe first emerged from a cave in their area, and brought their old established crops with them, maize being among them. I have no details of its use except that most or all the crop is used as it ripens and is not normally stored.

8. SANGTAM NAGAS:—

There are two geographically separated branches of this small tribe. I have visited the northern branch.

Varieties grown: I have obtained the following list and notes from a Government subordinate, himself a member of the tribe.

1. *Chemese*, sown in March and harvested June to July.
2. *Mesease*, meaning "sweet maize." Is regarded as good for making beer and is grown mostly in rocky fields.
3. *Nurachese*, a small popcorn maize.
4. *Hengchimerem*, used both for human consumption and for pig feed.
5. *Yengchengese*, used mainly for beer and for pig feed.
6. *Abochese*, not regarded as very good, but grown as it is ripe earlier than the rest.

Unfortunately, my small collection from the northern Sangtam area got rather mixed and labels lost. I can, however, note that of the above No. 2 is a small red-grained type similar to but larger than Serial 6. No. 2 (*Mesease*) is a very small white-grained popcorn identical with Serial 12. No. 4 (*Hengchimerem*) is a fair-sized maize with large, coarse grains, and a proportion at least are red. No. 6 (*Abochese*) is a stout rather coarse type with large hard yellowish-white grains.

Ecology, technique: The northern Sangtams live in steep country, and grow their maize mixed with millet in their ordinary fields.

Use: The above list shows the main use of maize and I have little to add. Most is said to be eaten when soft, but a proportion is stored for the winter, when its main use, except in seasons of rice shortage, is for beer. It is a fairly important catch-crop, probably more so than among the Ao and Lhota Nagas. Much of the Sangtam area (as among the Chang Nagas) is high and cold and unsuited for rice growing.

Storage: In baskets, after shelling, in the granary.

Folklore, traditions, etc.: The Sangtams simply informed me that they have always had maize among their crops, as far back as their traditions reach.

9. RENGMA NAGAS:—

I have never visited this little tribe, which is split into two geographically separated parts, of which the eastern branch is very primitive. Writing of the eastern Rengmas, J. P. Mills ("The Rengma Nagas," 1937, p. 86) states:

On the *jbum* maize is a far more important crop than it is in the Western Rengma country. It is both eaten boiled and used for brewing. Ordinarily it is sown scattered among the Millet (*achota*, the *Sorghum*) with which it is harvested, but some men grow whole fields of it.

Of the western branch of the tribe, the same writer says (l.c., p. 77): "Maize—though an important crop among the Eastern Rengmas, is little grown by the Western Rengmas. At most a few plants are grown among the rice and the heads roasted and given to children to eat. Occasionally a brew is made from it nowadays, but the resulting beer is not popular." The words for maize are (both from Mills): Western Rengma—*Samphuruchi*, and in Eastern Rengma—*Akbuzi*.

Mr. Mills has recorded from the Eastern Rengmas (p. 88):

Early in August there is a series of five "genna" days. The first day is called *Atsetatsate*, and is held to prevent waste of food. The next four are called *Tsate*, the festival of formal first fruits, that marks the beginning of the maize and millet harvest. Young men go to the fields and bring back leaves of millet, which only the women eat, or pretend to eat raw. Men also bring in Maize-heads that day. These are not eaten that day, but kept till the next day but one following, when everyone eats roasted Maize. Throughout this "genna" all work ceases and people entertain their friends at drinking parties.

10. THE LUSHAIS:—

Varieties grown: L1–L8 as sent. A list of the types grown, as sent me by a reliable government subordinate is:

1. *Ralte Vaimin* (Serial L1), regarded as indigenous.
2. *Pawi Vaimin* (Serial L5), meaning "Chin Maize."
3. *Sap Vaimin*, meaning "European Maize." This variety is a dented maize recently introduced by the British.
4. *Bawngpu Vaimin* (Serial L7), meaning "Herdsman's Maize." This is a large coarse flint maize introduced by Nepalese immigrants (the "Herdsman").
5. *Chingzo*, meaning not given.
6. *Vai Vaimim* (Serial L4), meaning not given.
7. *Lenliam* (Serial L6), meaning not given.

Nos. 5, 6, and 7 are regarded as similar, and have small, dark-grained ears noted for the stickiness of the grain while soft.

8. *Puakzo* (Serial No. L8), meaning "Burst all," as it is grown for use as popcorn.

Ecology and technique: I have not visited the Lushai Hills, but have first-hand information that, as among the Nagas, maize is grown among the other crops in the dry *jhum* fields, and occasionally as a pure crop. In the latter case I am informed that it is usually followed by a legume crop. The seed is dibbled, and the sowing season is said to begin in April, with the harvest from July to August.

Uses: The bulk of the crop is eaten, boiled or roasted, as it ripens, and is thus a catch-crop as among the Naga tribes. It is also used to some extent as pig food, and a little fed to poultry. Limited amounts are stored (presumably by poorer people, and in lean years), and the grain is roughly pounded and mixed with rice. The small *Puakzo* is probably grown entirely for popcorn. I have no information of maize being used for beer, and I think it to be so used very seldom. Some of the

Lushais in the high-altitude eastern areas with a cold climate use maize as a main crop; this is due to lack of a high-level rice, and will be described under the Chin tribe.

Storage: I have no information.

Traditions, folklore, etc.: Lt. Col. J. Shakespear ("The Lushai Kuki Clans," 1912, p. 87) states that there is a festival known as *Mim-Kut*, named after the Maize, as it takes place when the crop ripens. It is of but little importance and seems likely to die out. Cakes of Job's-tears are eaten, and the next day is *brilb*. N. E. Parry ("A Monograph on Lushai Customs & Ceremonies," 1928, p. 91) refers to this feast as being in honor of persons who have died during the past year. He mentions that the "Fresh vegetables, maize, bread, necklaces, & cloths are placed on the memorials of the dead."

Shakespeare remarks of the chiefly clan of Fanai, who originated from the Chin country to the East (l.c., p. 139): "A dead Fanai is buried in the usual Lushai way, but no rice is placed in the grave. An offering of Maize is however suspended above it. It may be noted that in the Zahao country rice is not cultivated, the staple crop being maize."

It is possibly an exaggeration that maize is the only main crop in this area: but I have had it confirmed by members of the Lushai tribe that it is more important than rice.

11. THE LAKHERS:—

I have not visited this tribe, which lives next to the South Lushais. Their system of cultivation is the same as among the Lushais, and it is reasonably certain that maize is grown in the same way, and is of the same importance. The Lakher word for Maize is *Cbhamei*. Rice is the staple crop. A minor use of the dry grain is mentioned by Mr. N. E. Parry ("The Lakhers," 1932, p. 199), who states that it is used for counting. The same authority describes a very interesting dance performed in one village in connection with the maize harvest (l.c., p. 434):

In Chapi village, to celebrate the gathering in of the Maize harvest, a dance called *Pazutawla* is performed. The men hold hands and form a ring; the girls stand in front of them; one girl stands between two men, and puts an arm around the shoulders of the men on each side of her. They dance round and round, singing to the accompaniment of gongs and drums. The dance is peculiar to Chapi. It is *ana*, to dance it except in celebration of the maize harvest, and were it performed at any other time those taking part would suffer from carbuncles.

12. THE CHINS:—

In the Chin Hills, which are politically within the borders of Burma, maize is a very major crop. All my information is from "The Economics of the Central Chin Tribes," by H. N. C. Stevenson (1943).

Stevenson lists maize as among the staple crops (p. 35) and states that it is grown along with millets and beans. The system of cultivation is as a mixed crop in the *jbum* fields. The ears are stored, hung from the rafters of the dwelling-house. He implies that it is of equal importance with rice. It seems to be used

both fresh and after being stored; it is used, mixed with rice and millet, for beer-making.

Stevenson gives interesting notes on uses of stored maize. Thus under "Travel Rations," which he describes as being the most common form of cooked food in pre-annexation days, owing to constant danger of raids, he includes . . . : *Vainiim kan*.—"As the name implies, this is roasted maize, and it is prepared in exactly the same way as *Vai kan*. Occasionally, when it is to be eaten the same day, bananas are pounded into the grain as a change of flavour."

He describes the *Vai kan* just referred to as follows:

The name means roasted millet, *faang klawr* again being the variety used. The grain is soaked in water for a minute or two to damp it thoroughly and is then steamed as if to prepare it for fermenting, after which it is spread on mats to dry in the sun. In the final stages of preparation the swollen grain is roasted in a *peibung* until it bursts like puffed wheat. The whole is then pounded with salt or honey and made into convenient lumps which are taken on hunting parties, etc. *Vai kan* is regarded as best of all foods for "sticking to the ribs" but it is very dry, especially the salted variety, and for this reason is not used during hot weather in areas where water is scarce The *peibung* is the traditional grain-roasted pot, shaped rather like a beer-pot, but with a large hole in one side. Its very existence proves the antiquity of the roasting method of cooking.

The same authority lists under the heading "Daily food in the home":

Thiab Var:

This is the commonest food of the present day, and it is generally made with maize, millet being reserved for beer-preparation or the travel ration. The maize is pounded to break the grains and then sieved and boiled in water. It is eaten with any sauce that is going, after the liquid has been drained off. When consumed as a broth with the water in which it is cooked it is called *ti sawp*, and if pumpkin and other leaves are added as a flavoring it becomes *bub ber*.

The harvest is apparently later than in most of the Assam Hills, presumably for climatic reasons. Stevenson states (l.c., p. 41):

No sooner is the millet crop safely gathered than the maize ripens in August and September. In harvesting maize also the Chin use no knife but tear the cobs off by hand, removing the outer cover and turning the inner ones back to act as ties when the cobs are eventually stored under the rafters of the house.

With regard to the use of maize for beer-making, Stevenson records (l.c., p. 113):

In the Central Chin Hills there are three recognized types of beer: *zu ha*, made from first-quality cleaned millet; *zu pi*, made of husked millet mixed with its chaff; and *vainiim zu*, made from Maize [*vainiim zu*] is made of pounded Maize, which after being soaked for a day to soften is treated like the millet used for *zu ha*. Like *zu ha*, it will not keep for long and is therefore prepared shortly before use. This *zu* being the cheapest, is most often used in the home on day-to-day occasions.

Maize seems to be too important for human consumption to be given directly to domestic animals. Stevenson notes, however (p. 114): "Incidentally, fermentation of grain for beer does not waste the solid residue: this by-product is added to the pig-food and gives strength and substance to the unappetizing bulk of banana stalk which is the other main ingredient." As a corollary to this, I may add that this use of the fermented grain of millet, rice, maize, etc., for feeding pigs is a

universal practice among all the Nagas and other tribes.

The Chin word for Maize is *Vainim*.

13. THE KUKIS:—

The Kukis live in the Southern Naga Hills, and in Manipur State. I have once visited a few Kuki villages in the former area, among whom maize was grown and used in precisely the same manner as among their Naga neighbors: as a catch-crop for consumption while fresh, for popcorn, and to a small extent for beer-making. The same types are grown. The name for Maize among the Thadou branch of the tribe is *Kolbu*, which is said to mean "Burma Food": an interesting point since the Thadou Kukis are generally regarded as having close kinship with Northern Burma.

14. THE MIKIRS:—

The Mikir tribes have been very little studied. Their system of shifting cultivation is very primitive. Maize is among their subsidiary crops. I have been told by a member of the tribe that the large-grained types are most grown, but the small types are also used. The Mikir word for maize is *Thengthe*. I have not been into the Mikir Hills.

15. THE KHASIS:—

Varieties grown: The Khasis have for generations been in close contact with the British, Nepalese and Indians, and Asiatic, African and American varieties have been introduced and are by now inextricably mixed with older types. Most of the tribe cultivates at over 4,000 feet, and it is doubtful if the small-grained types were ever used to any extent.

Ecology and technique: As a mixed crop, together with rice, millet and Job's-tears. Nowadays the Khasis have a large-scale potato-growing industry, and maize is often grown in the potato plots, interspersed between the rows of potatoes. It is also grown as a pure crop.

Uses: The original uses were for food, mainly as a catch-crop, the ears being eaten boiled or roasted. Some is put aside for popcorn, and in parts of the area it is prepared by placing the grain, with some sand, in the cooking-pot, and heating it over a fire. Maize is become a fairly important cash crop for sale in the bazaar at Shillong. It is used to some extent as pig food.

Storage: Very little is stored, except for seed. The ripe ears are hung up in the house.

Traditions, folklore, etc.: The Khasis state that maize is among their ancient crops. The word for it is *Riew Hadem*, meaning "Grain of the Hadem People." The Hadems are a small branch of the Kuki tribes who live in close contact with the Khasis in the extreme southeast of their area.

16. THE GAROS:—

Varieties grown: G1–G5.

Ecology and technique: The seed is dibbled in lines among the rice and other crops in the *jbum* fields. It is sown about March in most parts and harvested in

June. In some of the warmer areas it is often planted earlier, and I have seen plants with the ear already formed in April.

Uses: Although the staple crop of the Garos is rice, they are hard-pressed for land and food is often short. Maize is an important catch-crop, and is almost entirely used as it ripens. The fresh ears are either boiled or roasted. Very little is stored, and this stored grain is pounded and eaten boiled, either alone or with rice. The smallest variety grown is used only for popcorn, and is prepared by heating it in a cooking-pot with a little sand. Maize is too precious for human consumption ever to be used as pig food; and is said not to be used for beer, which is made entirely from rice.

Storage: When stored for winter use, it is stripped from the ear and put in round baskets. Stock for seed is hung up in the dwelling-house.

Traditions, folklore, etc.: The Garos say they have always grown maize, and got it with their main crops "out of the ground."

* * *

All the foregoing tribes live south of the Brahamaputra, which has always been an effective, but by no means absolute, barrier to contacts of culture. The notes which follow describe the cultivation and uses of maize among the tribes of the outer Himalayas, within the political boundaries of Assam.

17. THE DAFLAS:—

Varieties grown: Serial Nos. 1-4.

Ecology and technique: Maize is grown as a mixed crop along with rice and millets, under the same system as among the Naga tribes. It is the earliest crop sown, and is often dibbled in before the rice, the usual month being March, although I have seen fields sown in February.

Uses: Rice is the staple food among this large tribe, but their technique of shifting cultivation is slovenly and haphazard, and probably for this reason, subsidiary cereal crops of millet and maize are of considerable importance to supplement the rice supply. Maize is both grown more than among the Naga tribes, and much more, perhaps most of the crop, is stored for winter use. I have not been to the Dafla country while the maize was ripening, and cannot say to what extent it is eaten fresh and functions as a catch-crop. However, in normal seasons, it is a subsidiary crop to help out the rice in the winter rather than a catch-crop for immediate use. In the summer following a poor harvest, the people would, of course, be forced to use their maize as soon as it was developed enough to eat. The main use of the stored maize is for food, since the grain is more easily broken up and mixed with rice. For this reason, the smaller-grained of the main types is preferred since the grain is more easily broken up by the pestle-and-mortar grain-pounders. Sometimes it is crudely milled between flat stones. A proportion of the maize is mixed with millet (Eastern Daflas) or with rice (Western Daflas) for beer-making. In good seasons it is used for pig food. Even the dried ears are

often roasted and eaten off the cob. I have several times seen them given to children as "snacks" between meals. All types are used for popcorn. For some years past, Daflas living fairly near the Plains of Assam have carried on a small trade in maize with tea-garden coolies. The Daflas grow only the larger-grained types, and have far fewer types, partially accounted for by the different status of the crop since the large-grained types are clearly more economical for storage than are the small-grained. Climatic factors may, however, enter into it, and it is also perfectly possible that the Daflas have never had the smaller types as grown on the Assam-Burma border.

Storage: Maize is stored in the granary along with other grains. Among the eastern (and more primitive) section of the tribe it is kept on the cob, and the ears are heaped up in a roughly-made rectangular bin in one corner. The western Daflas strip the grain from the cob and store it in large round baskets, usually with the cobs wedged over the top as a protection against rats.

Traditions, folklore, etc.: I have several times questioned Daflas on this. They simply state that they have always grown maize. The Dafla word for maize is *Topothe*. The smaller type grown (Serial 4) is known as *Nyamatuṭ*.

18. THE ABOR TRIBES:—

I have only visited the Padam and Minyong Abors. The other main tribe are the Galong Abors, whose country is adjacent to the Daflas and who are probably very closely related to them. The following note deals only with the Minyong and Padam Tribes.

Varieties grown: Nos. 1-4 (of first consignment).

Ecology and technique: The Abors grow their maize as do all other shifting cultivators as a mixed crop among their rice and millet. They are, however, unique in that they practice double cropping. The first crop is sown during the month of February and is harvested in June. As soon as it is ripe, a second sowing is made in the same field, and is harvested in October.

Uses: The first crop of maize is used purely as a catch-crop, and is eaten while the ears are soft, either boiled or roasted. The second crop is left standing until the ears are thoroughly ripe and the grain hardened off. It is then stored and used during the winter either as a food or for making beer. The proportion that goes for beer-making or for food is said to vary with the economic position of the household and the general abundance of the crops in any one year. In general, maize is an important crop, although rice, Job's-tears, and millet are the staple foods. It is used to some extent for pig feed. Popcorn is also made, but not to any extent.

Methods of Storage: The grain from the second sowing is stored, stripped from the ear, in round baskets in the granary.

Folklore, traditions, etc.: The Abor tribes simply state that they have always had maize among their crops. Their folklore credits them with having obtained

all the main crops "On the horns of the tame Bison," and I have been told specifically that maize is included. The name among the Minyong and Padam sections of the tribe is *Sepa*. The main type used (a large golden or red flint maize) is called *Pade-Pasing Sepa*.

19. AKA TRIBE:—

I have not visited this small tribe, but I have met and talked with several members of it. They all told me that their most important crop is maize, which is grown in their fields along with dry rice. According to my informants, the Aka tribe originated in the Assam Valley, whence they were driven up into the hills many generations ago. At that time their main (or only) crop was rice, and they learned to use maize from the Monba tribe immediately to their west. They informed me that they grow the same varieties as the Monba tribe. The average altitude of cultivation in the Aka Hills is of the order of 5,000 feet.

20. MONBA TRIBE:—

Varieties grown:

1. *Phentang*. Serial Nos. 1 & 2 of first consignment.
2. *Num Phentang*. Serial No. M1.
3. *Khana Phentang*.

The first two are indigenous: the *Khana* is a South African dentate maize introduced a few years back by the government. *Khana* means tooth.

Ecology and technique: The Monbas differ from all other tribes of the Assam Hills in that they are a civilized people whose whole culture and social organization is of Tibet. They have a well-developed system of farming on permanent fields. Their maize is grown as a pure crop in rotation with other cereals and in the permanent fields. It is sown in May and June, and is harvested from late September to early November. The lateness of the sowing as compared with other areas is due to the need of fitting it in with their system of rotation. Sowing is entirely by broadcasting, and the ears are pulled off by hand. The variety *Phentang* is the most grown, and is in large fields. The variety *Num Phentang* is grown in small amounts, and is relegated to odd corners, edges of fields and to the few areas of shifting cultivation. The introduced dentate maize, *Khana Phentang*, is almost entirely relegated to the areas of shifting cultivation. The reason for the different technique will be clarified below.

Uses: The Monbas, with their advanced economy, grow a variety of grain crops, all of some importance. These include maize, barley, rice, buckwheat, millets, *Chenopodium*, cockscomb. However, with the exception of a few villages at 9,000 feet and above, the most important crop is maize, which is said to be more important than the others put together, and is the staple food. The main uses of the grain are:

1. For the ordinary food, the variety *Phentang* is ground to a coarse flour by

means of the ordinary Tibetan water mill. The flour is usually boiled. This flour is known as *Phentang bukpu*.

2. A small proportion of the same variety is eaten when the ears are still soft.

3. The *Phentang* is slightly roasted and then flattened and partially broken up by light pounding. In this form it is chewed as a relish, especially while liquor is being drunk, and plates of it are always offered to visitors. The local name is *kakung*. A great deal is consumed in this way, and the *kakung* is also an article of trade in Tibet.

4. The *Phentang* is used to a fair extent in brewing of beer and distillation of a weak spirit. This is said to be the use of the introduced variety *Khana Phentang*.

5. For popcorn, the variety *Num Phentang* only is used, and it is grown for that purpose only. It is popped by heating in an earthenware vessel with a little sand.

As far as I know, virtually all the maize crop is used for human consumption only, except that the "leavings" from manufacture of liquor go to the pigs. By far the most important type is thus the *Phentang*, a strong-growing, large-grained golden-yellow or occasionally red, flint type.

Methods of Storage: This aspect is also interesting. When the maize is ripe, the ears are left for some weeks on the plant to dry. They are then gathered, and the enclosing leaves removed. The ears are then stacked on the fields in solid rectangular panels up to 20 feet long, by 10 feet high, and perhaps 2 feet thick, the structure being raised off the ground by a slight framework of sticks. The panels are often L-shaped. A field, when the crop is stacked, is a beautiful sight dotted with these solid patches of golden yellow, the more so since the few scarlet ears are suspended over the top for color effect¹. The crop is left thus for a month or less to dry off thoroughly, after which the ears are carried home to the village, and the grain removed either by hand or threshing with a short stick. It is stored in large round baskets in the upper room of the two-storied house. The seed for next season is left on the ear and hung up on the rafters.

Traditions, folklore, etc.: The Monbas simply state that they have always grown maize, and that as far as their traditions go back it has been the staple food crop. On the other hand, they have a well-established tradition that they first got their rice from the Plains of Assam. By religion they are Buddhists (every other tribe in the Assam Hills is Animist), and it is both interesting and significant that the first ears of maize to be gathered are placed in the village temple as an offering, while they deny any such practice in the case of their barley which (together with their Buddhism) they must have obtained from Tibet. It is also a common sight to see a few ears of maize hung up as offerings inside the temple, or placed on small wayside shrines. I have asked members of the tribe if they have any special rites, dances or festivals for their maize, and in all instances this was denied. I would

¹It is possible that the original purpose of suspending the red ears was to ward off evil spirits from the fields.

not, however, like to state categorically that my informants were accurate. In dealings with tribal peoples knowledge of religious custom can only be got by long and close acquaintance or direct observation.

21. THE APA TANI TRIBE:—

Varieties grown: Serial Nos. 1–4 of first consignment (as for Dafla Tribe).

Ecology and technique: The Apa Tanis, although a primitive people without writing, etc., have a very highly developed system of irrigated rice cultivation for their staple food supply, and practice shifting cultivation extremely little, if at all. The maize is grown in small quantities in little garden plots in and around the village. The tribe inhabits a small area in the Dafla Hills and the varieties grown are the same.

Uses: Maize is not an important crop. A proportion of it is eaten soft on the ear. Some is stored, and is prepared by first roasting it in a clay pot and then pounding it to a coarse flour. It is said to be eaten mainly by old people with decayed teeth, but this needs checking. Popcorn is prepared in considerable amounts, and is made by putting the grain into the glowing embers of the fire, and picking it out with bamboo tongs as it bursts. I am not sure if the other method of heating the grain in an earthenware pot is used.

Methods of Storage: The small quantity stored is kept with the rice in separate granaries.

Traditions, folklore, etc.: I have no information.

22. THE MISHMI TRIBE:—

I have once visited a small section of this very primitive tribe, and have only the scantiest information. Their shifting cultivation is rough and ready. Maize is included among the crops and Mishmis have told me that it is of moderate importance. I have seen Mishmi women making popcorn by putting the grain in the edge of the house fire, and picking it out as it bursts.

MAIZE IN HILL AREAS OUTSIDE THE BOUNDARY OF ASSAM

BHUTAN:—

I have talked to many traders and others from Bhutan and am told by them that maize is grown everywhere, and is a fairly important crop. A large yellow type is said to be the most widely grown, and is presumably the same as the *Phentang* of the Monba tribe on the Assam-Bhutan border.

SIKKIM:—

As for Bhutan. Writing a hundred years ago, Sir Joseph Hooker ("Himalayan Journals," Vol. II, p. 78, footnote) states that he was given popcorn in North Sikkim. He describes it as, "Called pop-corn in America, and prepared by roasting the maize in an iron vessel, when it splits and turns partly inside out, exposing a snow-white spongy mass of farina. It looks very handsome, and would make a beautiful dish for dessert." Hooker also records (Volume I, p. 157) seeing, in May, 1848, the maize just sprouting in North Sikkim. He goes on to record the

curious statement that "This plant is occasionally hermaphrodite in Sikkim, the flowers forming a large drooping panicle and ripening small grains: it is, however, a rare occurrence, and the specimens are highly valued by the people." Unfortunately, he does not tell us if he actually saw such plants, or if he was recording from hearsay.

Maize is among the crops of the small Lepcha tribe of Sikkim. In his book "Himalayan Village" (published in 1938) Mr. G. Gorer refers several times to maize cultivation. He notes (p. 95) that wheat and maize are used for food when rice is short, but states that "they are not liked." He notes that the maize is sown in March (p. 94). This is confirmed by Major J. Morris in his book "Living with the Lepchas" (1938, Chapter 9) where he several times refers to maize as being among the crops raised by this tribe.

NEPAL:—

Of this region, I have the scantiest information. Nepalese immigrants into Assam have told me that they grow considerable quantities of maize in their own country. Maize is an invariable crop of these immigrants, even when they settle in the hot plains of the Brahmaputra Valley. They grow large yellow or white forms, the same or very similar to the main type of the tribes of the Assam Himalayas (Abors, Daflas, Monbas).

BURMA:—

Unfortunately, I have been able to get no information concerning the Shans, Wa's, Karens, or any of the hill peoples in Burma except the Chins as recorded above. Of the large Kachin tribe, who live in the extreme north of the country and whose hills are contiguous to the Mishmi Hills of Assam, Mr. J. L. Leyden has recorded (introduction to a pamphlet "The Kachins of the Hukawng Valley" by Kawlu Ma Mawng, 1944, p. ix):

The Kachins are rice eaters, and their agriculture is mainly concerned with the production of their staple food. Kachin agriculture is chiefly concerned in the extremely wasteful and inefficient shifting cultivation As the cultivation and sowing is crudely carried out the Kachins invariably find themselves with a poor crop of rice and are compelled to work subsidiary crops of maize, millet and yams to avoid starvation.

While this somewhat bald statement as to why maize and millet are grown can hardly be accepted at its face value, especially *vis a vis* the tribes of Assam, it at least indicates that maize is an established subsidiary crop, probably in very much the same way as among the Naga tribes.

MANIPUR STATE:—

The Naga and Kuki tribes of Manipur State are of the same stock as those of the southern Naga Hills (see above under Cachar Nagas and Kukis), and it is reasonably certain that they grow the same maize and in the same way as do their neighbors. The Manipuris proper inhabit the highly irrigated plain of the Manipur Valley. I have no information as to whether they grow maize, but consider it unlikely that it is of any importance as their fields give them a considerable surplus of rice.

HISTORY IN THE ASSAM HILLS

As we have seen, maize is grown by all the multifarious peoples of the region. This wide distribution does not in itself mean that it is of necessity an ancient crop. Once introduced and given favorable conditions for its spread, any crop can spread with rapidity, even in remote areas during a very few generations. This has taken place in the Assam Hills, a good instance being the potato. Another such crop is manioc, which is now grown in at least three widely separated ranges of hills. But both these crops are universally recognized as being introduced after the coming of the British. In the Garo Hills I was told by illiterate villagers that manioc has been grown by them for about twenty-five years; and in the northern Naga Hills it is said to have been with them for two or three generations. But in the case of maize I was simply told by every tribe that they have always had it among their crops, and any suggestion that it came from outside was ridiculed. An exception to this, as recorded above, is the Aka tribe, a small tribe of the Assam Himalayas, who believe their maize to have been obtained from neighboring tribes many generations back. I have constantly inquired in tribal villages, and particularly among the old men of the community, as to when and how they first got their main crops. The reply was always the same in regard to millets, taro, maize, Job's-tears, and yams. They have always been grown, and no one can say when or how they were first obtained. In some cases this is true with rice, now the staple crop among the majority, but there are indications that rice is a more recent food than the rest, although it is undoubtedly a very ancient crop and has been grown in Asia for some thousands of years. Thus, among the Chang, Yimchungrr, and some of the Konyak Nagas, the people even now depend on roots and cereals other than rice for their food supply and state quite openly that they are older crops, maize not excluded. The same is true of the Monbas, who have a definite tradition that maize has "always" been their main crop, while rice was obtained many generations ago from the Plains of Assam.

Furthermore, in the case of rice there are established legends to account for its origin. They have been recorded for the Naga Tribes by Professor Hutton and Mr. Mills (in the series of monographs on the Naga Tribes), and for the Lakhers by Mr. Parry ("The Lakhers," 1928), while I myself have been told folk tales by the Daflas, Minyong, Abors, and Khasis. But there is no legend known to account for the origin of the other cereals, millet, maize, and Job's-tears, the inference being that rice is more recent while the others are lost in the mists of antiquity.

The existence of a distinct name for maize is everywhere indicative of a respectable age, the more so when we note that in several cases where a variety has been introduced by the British or by Nepali immigrants, the fact is well-known. Among a few tribes, notably the Khasis and the Lhota Nagas, the tribal name is indicative of origin from neighboring peoples. This is not, however, quite conclusive, as the generalized name could be based on a variety got from the tribe in question and which supplanted older and more indigenous types.

My notes on the religious aspect are particularly scanty. However, the dance of the Lakhers, the use of maize in funeral rites among the Lushais in deliberate preference to rice, its importance as a votive offering among the Monbas, the part it plays among the agricultural ritual of the Rengma Nagas, and the existence of a special tutelary deity among the Chang Nagas, all point to its being a well-established crop, the more so since primitive peoples with animistic religion are invariably shy of incorporating new crops into their agricultural ritual.

The wide distribution, the positive statements of the peoples themselves, the position relative to the crop complex, the existence of distinctive tribal names, and the place in religion, all point to a long history, going back for centuries at least, for maize among the hill tribes of this region. As we shall consider immediately, this is fully supported by the general economics of the crop and the variety of uses to which it is put.

GENERAL ECONOMICS

This is a major study in itself, and the factors involved are many. Among them may be listed: (1) climate; (2) the varieties available; (3) techniques of cultivation; (4) other crops grown; (5) uses for which the crop is grown.

Taking first the climatic factors, the *climate* of the Assam Hill areas varies from sub-tropical to sub-temperate, and maize is grown at all elevations from a few hundred feet to 6,000 feet. In general, it is of more importance to the tribes living at high altitudes, a state of affairs not unconnected with absence of rice varieties suitable for cold elevations, as among the Chang Nagas and surrounding tribes, and possibly among the eastern branch of the Lushais and the Chins.

Varieties grown in any one area or by any one tribe are clearly dependent, within the limits of the climate, on the culture contacts, the purpose for which maize is needed, and so on. There is a far greater variety of types grown along the Assam-Burma border (Nagas, Lushais, and Chins) than in the outer Himalayas (Abors, Daflas, Monbas), although maize is on the whole more important in the Himalayan region. Since all tribes of the Himalayas store part of their maize, inspection of granaries after the crops had been harvested have enabled me to survey with reasonable accuracy the varieties grown, and the peoples of this region seem to cultivate only the larger coarser types, the small several-eared forms being entirely absent and apparently confined to the Assam-Burma border. These very distinctive small varieties are moreover grown at low altitudes, and I do not think them to be cultivated at elevations higher than 4,000 feet, so that they are all associated with the sub-tropical rather than the sub-temperate zones.

Although the climatic conditions of the inhabited parts of the Himalayas are, on the whole, colder than in the other hill areas with which we are concerned, there are thickly populated areas in the low sub-tropical foothills of the Abor country which are very similar to the outer Naga Hills; and the inference is that the tribes of the Himalayan region have never had these small maizes. This seems to link up

with the larger number of tribal groups in the Burma region and the greater frequency of migration to and from the area, as well as local movements within these particular hills, each group contributing its quota to the complex of crops over the passage of time and passing them on by local diffusion. Leaving aside any possibility of a variety having originated at some remote period in the area where it is now grown, each tribe seems to have accumulated its types of maize by culture contact.

For reasons given I do not consider that there has been any great production of varieties by hybridization. In the data recorded above some support is given to this origin of varieties within a tribe. Thus the Lushais regard a proportion of their maize varieties as their own, one as obtained from their Chin neighbors, and two as of recent introduction from the Nepalese and the British. The Lhota Nagas of the hotter foothills have three varieties they regard as indigenous, or at least of very ancient introduction, one obtained from the Angami Nagas, one from the Ao Nagas, and one from the Nepalese. It is stressed that the word "indigenous" implies only that a variety has been grown for a period for its ultimate origin to have been forgotten in the traditional memory of the tribe, and in no case necessarily means that it originated with them.

Technique of cultivation:—As indicated already, in the majority of cases the maize is grown in lines, small patches, or single plants among the other cereal crops. Only among the Monbas with their advanced farming, the Angami Nagas and the Apa Tanis with their system of irrigated rice growing, and perhaps among the Lushais, the Chins, and Akas, is it normally a pure crop. At first sight, this rather haphazard technique seems conducive to hybridization, particularly where five or six types are grown by a single village. But examination of granaries shows but a small proportion of parti-colored ears. The reasons are not far to seek. In the first place, there is a general prejudice which I have often heard expressed against saving seed from any plants which do not look pure bred; secondly, as I have demonstrated by experiment, different types flower at long enough intervals apart to act as a fairly effective check on cross-pollination; thirdly, all types are not extensive, but in every area I have visited, a walk through the fields shows different types grown in different stretches of land and certain types are definitely looked on as more suited to distinct soils and elevations. In clarification of this, it is important to remember that a village community cultivating on hill slopes will almost invariably have in use at any one time fields varying up to several hundred feet in height above sea-level, with corresponding diversity of exposure to winds, etc. It therefore stands to reason that where different varieties of any crop are grown they will be dispersed according to individual suitability to local variations in climate and soil conditions. As a general rule I have seen the larger-grained types of maize relegated to the higher-altitude fields, while the small popcorns and several-eared forms are sown on the lower, warmer slopes. Finally, the tribes are perfectly well aware that sowing different varieties mixed together leads to the

hybridization they are anxious to avoid, and for obvious reasons deliberate segregation is practiced.

Uses to which maize is put: Within the limits of the climate and the varieties available, the purpose for which maize is grown is naturally the determining influence of every aspect of a crop, maize as much as any other. As the whole background of the economics, is the major fact that in the Assam Hills *rice* is the cereal crop preferred above all others, and wherever it can be grown and suitable types are available it is now the staple cereal. In qualification of this, we have already referred to maize as being the main grain crop among the Monba tribe of the Assam-Bhutan border. Members of the tribe have, however, told me that they prefer rice when they can get it, but since their arable land is limited and there is very little fit for irrigation, it is more economical to grow maize as a main crop. In a somewhat similar way, among the Chang Nagas and neighboring smaller Naga tribes, millets, maize, and Job's Tears are the most important cereal crops largely because the people have no rice varieties suitable for the cold altitude of their lands. Within the past two or three years the Chang tribe has made requests to the government to help obtain seeds of rice suitable for this cold climate. I do not know if this applies among the eastern Lushais and the Chins, but the inference is that it does, since the Lushais dwelling in warmer parts of the hills are all rice cultivators. The detailed uses of maize as outlined above are:

1. A catch-crop, eaten while the grain is soft. (All tribes.)
2. Stored for food in the winter, either as a reserve secondary to rice, or more occasionally as a main crop.
3. For beer-making.
4. For popcorn.
5. For pig food.
6. As an article of trade outside the village.

The first named is the most universal use of the crop, and applies to all tribes. For eating fresh, as a catch-crop, the smaller, several-eared types (other than the popcorn) are often preferred by those who grow them. This is apparently due to their soft, sugary grains which are appreciated both in themselves and as an alternative to the harder less sweet types. I think this to be the main reason for survival of these small types, since the grain is not nearly so economical for storing as winter-food as are the larger, "coarser" forms, and I know of no tribe which stores the smaller varieties for any purpose other than popcorn and perhaps for beer (*vide infra*) to a very limited extent. A point of some importance in connection with the use of maize as a catch-crop and for immediate consumption is the fact that different types grown in the area in question differ very appreciably in the time taken to mature, the small several-eared forms being several weeks slower than the larger types. It is of course well known to the peoples who grow them, and who naturally therefore space out the crop on this basis, to cover as long a period as is necessary.

The dried, ripened grain stored for the winter is, as we have seen, of primary importance among the Monbas, Changs and neighboring tribes, the Chins, and Eastern Lushais. It is of secondary importance among the Daflas and the Abor tribes, and the Sema Nagas, and is of fairly minor importance among the rest. It is, however, essential to maintain a balanced perspective and to remember that while statements of this kind are accurate in general terms, the whole balance of crops and their use is naturally fluid, especially among a primitive tribe with a comparatively unstable economy, and any general picture is only true for the actual time a survey is made. Thus, local conquests of tribe by tribe were taking place in the Naga Hills and elsewhere before British Administration was introduced, conquests which were accompanied by varying degrees of change in the pattern of culture, the crops not excluded. Nor has change ceased since more settled administration was started. In most hill areas of Assam, the government has constantly been trying to persuade tribal peoples to change over from shifting technique for mixed crops to permanent irrigated cultivation for rice.

Similarly, in a more restricted sense still, a season of poor rice harvest in the autumn means that the supplies for the winter and following spring will soon be exhausted, and under these conditions a people such as the Daflas who normally consume a proportion of their maize as it ripens and store a proportion for beer and a reserve of food during the winter, will naturally use a greater amount for food and less for liquor, and *vice-versa*, after a good harvest, when there will probably be even a little to spare for the pigs. To narrow this down even further, from the tribe or the village to the individual household among peoples for whom rice is the most important of many crops, the subsidiary crops of maize, millets, and roots are naturally most important for the poorer people of the community whose rice supply runs out before the end of the season and the start of the next year's main harvest, and who live rather from "hand to mouth" depending to a greater or lesser extent on the "catch-crops" for their main food supply.

The use of maize for beer is governed by the same factors as for food. Among most tribes rice is preferred for beer-making. Possible exceptions to this are the Sema Nagas, who seem to use maize from choice, and the Eastern Daflas, who grow considerable quantities of millet solely for beer. It follows as a natural sequence that the worse the food crops in any one season, the less will be spared for beer and the more will be needed for human consumption. Very often beer is made from a blend of a variety of ingredients, the technique varying even from village to village within the same tribe, and maize will normally be included in the list of grains used for the brew. Thus, among the Chang Nagas I have been told that beer is made by mixing maize, Job's-tears, millets, and *Chenopodium* in fairly definite proportions. I have not been able to discover that any maize variety is used or grown specifically for beer, but this is a point calling for more detailed investigation.

Popcorn is used everywhere, and special varieties are normally grown for this purpose only. The popcorn is made either by roasting the grain in a pot, often mixed with a little sand, or by simply placing the grains at the edge of the fire and picking out the popped grains with bamboo tongs as they burst.

The above notes deal with maize among the tribal peoples of the Assam Hills, and the plains areas of the Brahmaputra Valley and the southeast of Assam and Pakistan have not been considered since maize is not grown there by the indigenous population. It is, however, possible to grow it in the plains, and it is a common crop among Nepali immigrants. It is therefore perfectly feasible that it was grown in past epochs by the aboriginal population of the Assam Plains who might well have abandoned it with the development of a highly organized system of irrigated cultivation for rice.

PART II

EDGAR ANDERSON

The data reported in this paper are basically simple, being essentially a morphological survey of the varieties of maize grown by the Naga. However, the accurate assembling of these critical data required the cooperation of a number of individuals and institutions. The varieties collected by Stonor were numbered by him, and selections from most of them were grown in his experimental plot in Shillong, Assam. Herbarium specimens of the tassels and photographs of several of the more outstanding varieties were then forwarded to the Missouri Botanical Garden. Samples of the original ears collected by Stonor were sent to the Royal Botanic Garden at Kew where they were photographed. The ears were then shelled and the seeds, identified by their original numbers, were sent to the United States, where they were fumigated and forwarded to the Missouri Botanical Garden. The empty cobs were imported separately and were sterilized by heat before being released. These extraordinary precautions were necessary because two of the worst diseases of maize are found in southeastern Asia. At the Missouri Botanical Garden samples of the seeds were germinated and the seedling characters were studied. Several representative cobs were turned over to Dr. L. W. Lenz for histological examination and were included in his recent (1948) survey. Early the following spring the seeds were forwarded to Dr. E. G. Anderson of the California Institute of Technology where they were planted in the maize-breeding plot at Arcadia, California, one of the most favorable sites in this country for tropical maize. With the cooperation of Dr. A. E. Longley of the U. S. Department of Agriculture and Dr. William L. Brown of the Pioneer Hi-Bred Corn Company, material for cytological examination was obtained from many of the cultures and chromosome knob numbers and knob positions were determined from pachytene smears. During the growing season I worked at Arcadia for ten weeks where all the cultures, aside from a few late-maturing varieties, were scored for plant color, representative plants

were photographed to scale, herbarium specimens were made of tassels, internode diagrams were made of mature plants, and the details of tassel and ear morphology were recorded. Eventually all the data and materials were assembled at the Missouri Botanical Garden—the herbarium specimens and photographs from Shillong, the photographs and shelled cobs from Kew, the photographs, herbarium specimens, and notes from California, the knob counts made by Dr. Brown and myself, and the histological information from Dr. Lenz. We are also indebted to Dr. Herschel Roman and Mr. Earl Patterson for internode measurements and specimens of varieties which matured after I left California.

The following collections were grown; the information concerning each variety was supplied by Mr. Stonor:

SERIAL No.	LOCALITY	TRIBE	REMARKS
1	E. Dafla Outer Himalaya	E. Dafla	Sown Feb.–March; ripe June. Much grown at 3000 ft. Local name <i>Topothe</i> . Number of ears 2–4.
5	N. Cachar Hills	Kuki	Grown at 2000–3000 ft. Number of ears 4–5.
6	N. Cachar Hills	Kuki	As for 5, with which it is grown.
7	N. Cachar Hills	Zemi Naga	Grown at 1500–4000 ft. No precise details. Said to give 2–3 ears. Sown about March.
8	N. Cachar Hills	Zemi Naga	Grown at 2000–3000 ft. Said to be slow-ripening. Gives 4–6 ears. Sown about March.
9	Naga Hills	Angami Naga	Grown at 3000 ft. Details as for 8.
10	Naga Hills	Angami Naga	Grown at 3000–4000 ft. No other details.
11	Naga Hills	Angami Naga	Grown at 3000–4500 ft. No other details.
12	Naga Hills	Ao Naga	Grown at 3000–4000 ft. Sown Feb. to March; ripe June–Sept. Said to bear 7–8 ears. Local name <i>Lozar</i> .
13	Naga Hills	Ao Naga	Grown at 3000–4000 ft. Sown late March; ripe June–July. Has 3 ears. Said to be very sweet. Local name: <i>Mapok Memdi</i> .
14	Naga Hills	Sema Nega	Grown at 3000 ft. Sown March to April; ripe June to July. Has 3–4 ears. Local name: <i>Azbeu</i> .
15	Naga Hills	Sema Nega	Grown at 2000–3000 ft. Sown March–April; ripe June–July. Said to have 6 ears. Local name <i>Azehuge</i> .
16	Naga Hills	Sema Nega	Grown at 2000–3000 ft. Sown March; harvested July. Said to be sweet. Has 2–3 ears. Local name <i>Mesbeu</i> .
17	Naga Hills	Sema Nega	Grown at 3000 ft. Sown March–April; ripe June–July. Has 2–3 ears. Local name <i>Kolami</i> .
18	Naga Hills	Sema Nega	Grown at 2000–3000 ft. Sown Feb.–May; ripe May to Sept. Has 6–7 ears (verbal report). Local name <i>Anila</i> .

In addition, seven varieties collected in the Lushai Hills were grown. Since they were in general very similar to the above and included no peculiarities not represented in the Naga collection, no detailed account of them has been prepared.

General Appearance:—

As compared with most collections of native varieties from South and Central America, one of the most outstanding characteristics of these Assamese varieties was the uniformity of several of the varieties and their differences from each other. This bears out Mr. Stonor's remarks as to the skill and determination of the Naga in keeping their varieties pure. Several of the cultures, though grown directly from seeds collected among the Naga, were as uniform as a good inbred line. It is probably significant that those varieties which were most unlike anything previously known in our studies of exotic maize were the most uniform, while the one variety most closely resembling the maize of Latin America was among the most variable (see below under "Caribbean"). The conspicuous differences between certain of the varieties make it difficult to generalize about them as a group; nevertheless there were certain definite trends which characterized the entire collection. Almost without exception these trends were most strongly marked in those kinds which morphologically were the most extreme such as "Late Upright" and "Late Sidewise."

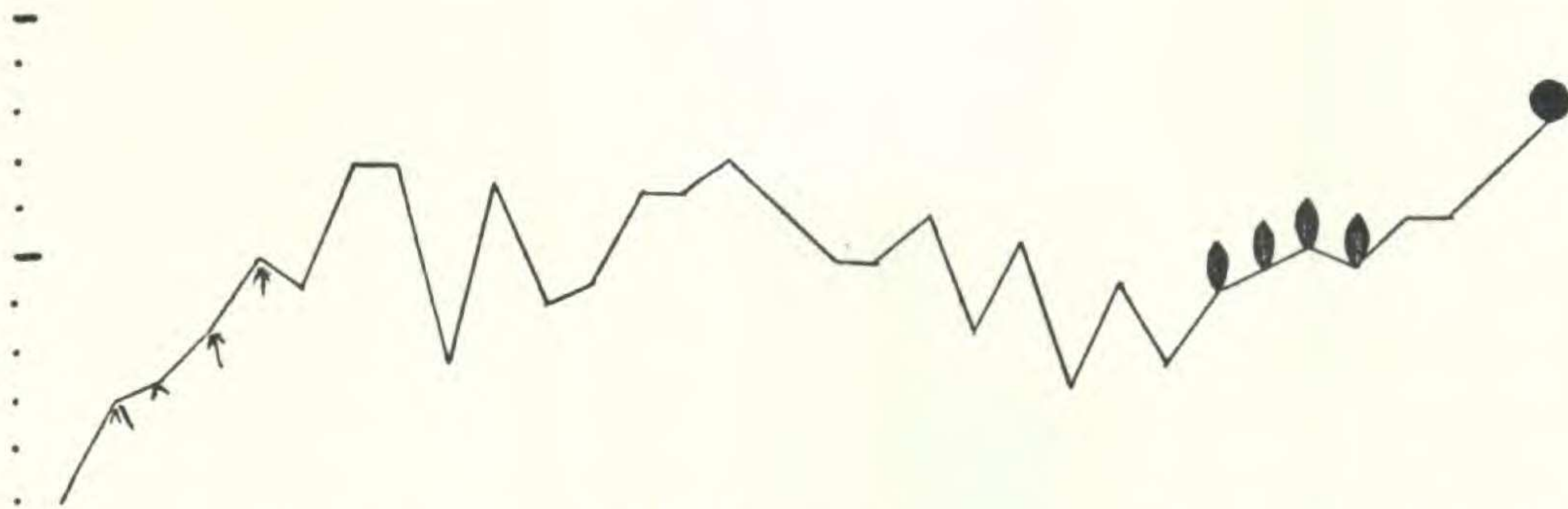


Fig. 1. Internode diagram of one plant of Stonor 18 ("Late Sidewise"), grown at Arcadia, Cal. Circles represent tassels, elliptical figures ears. The diagram is as if the stalk were cut at the nodes and the dissected internodes were laid side by side in succession, the lowest at the left, the uppermost at the right, and then a line (the line seen in the diagram) were drawn connecting their summits. The scale at the left (in centimeters) indicates the lengths of the internodes. It will be noted that there were over 30 nodes on the plant, none of which was over 8 cm. long; that there 4 ears; and only 4 short internodes between the upper ear and the tassel. Small lines at the left of the diagram indicate nodes at which there were well-developed prop-roots.

Figure 1 shows a drawing to scale of a typical seedling. The short, narrow tap-root, the numerous adventitious roots from the mesocotyl, and the broad mesocotyl and coleoptile are characteristic.

One of the most unexpected characteristics of these varieties was their green color. Not only were they mostly without the bright plant, tassel, and silk colors of so many Latin American varieties, but some of them had no visible anthocyanin pigment in any part of the plant. The group as a whole had a strong tendency to green silks, green anthers, green leaves, and green culms. There was also a strong tendency for the leaves to have a more evenly green appearance, like certain varie-

ties of *Sorghum*. In nearly all the maize of the New World there are minute differences in the intensity of the green above and between the veins, giving the leaves macroscopically a kind of longitudinal grain. The Assamese varieties tended to be evenly green throughout like a green plastic dish.

The collections among the Naga were outstanding in their lack of vigor, and this was quite as true in Shillong, Assam, as in Arcadia, California. Some were mid-season, others late or very late, but all of them developed slowly. From the time the tassel made its first appearance until it was completely out of the leaves and shedding pollen, as much as four weeks might elapse. One of the most outstanding characteristics of the maize of the New World is its vigor. Nearly all maize varieties grow and develop rapidly; the controlled heterosis of hybrid maize is merely an extreme standardized example of a tendency nearly universal in the New World. This vigor was absent in the Assamese varieties. Whether midseason or late in their maturity they poked along from week to week. The internodes were short; in the most extreme variety none of them was over 10 cm. in most plants. Nor was this the result of their having been transplanted from Assam to California, since the samples grown by Stonor in Shillong exhibited these same characteristics.

The internode patterns were highly peculiar. In addition to short internodes, the varieties from the Naga tended to have many ears (as many as four or five in some varieties), and the internodes above the ears were so short and crowded that the silks of the uppermost ear were sometimes tangled in among the lower branches of the tassel (see plate 22). Not only were the upper leaves crowded together but as Collins noted (1909) in his description of waxy maize from the Orient, they all tended to be gathered at one side of the culm and to hang over the developing tassel like a kind of spathe. While this character was more extreme in some varieties than in others, there was a marked tendency in that direction throughout the collection.

The arched and drooping spathe-like upper leaves were accented by the drooping and semi-included tassels. Tassel branches tended to be more slender than those of New World varieties, and in the more extreme varieties they hung down vertically until after the pollen was shed or even later. Though the tassel branches were long, the glumes were small. Because of the short upper internodes the tassels were never exerted from the upper leaves as pollen started to shed and many of them were not exerted even when fully mature.

For the ear the prevailing tendencies of the collection were to small cobs, prominent glumes, small, isodiametric kernels, and complete absence of row-pairing. The colors of their kernels were mostly a pale straw-yellow or a dull reddish-blue.

In their even green color, included tassels, slender culms, slender tassel branches, isodiametric kernels, straw-colored or dull blue kernels, these Assamese varieties resembled sorghum more closely than do New World varieties of maize, and one

variety even had a bluish-green bloom on its leaves rather similar to that which is so characteristic of certain varieties of sorghum.

Among the collections from the Naga a number of different sub-types could be distinguished. It seems unwise to dignify them with permanent names until we know more about the kinds of Oriental maize than we do at present. For the purposes of this discussion they may be provisionally designated as follows: I—Caribbean; II—Early Slender; III—Late Upright; IV—Early Upright; V—Late Side-wise; VI—Drooping Waxy. Some of their characteristics are shown in tabular form in table 1.

I—*Caribbean*: Types of maize fairly similar to those grown around the Caribbean basin are widely distributed in the Orient and were apparently introduced by the Spanish. They seem to be the prevailing type in the Philippines and in Guam and they or mixtures with them make up the bulk of the maize grown in Asia, particularly at lower elevations and along the coasts. In previous years I have grown collections from India, Guam, the Philippines, Sumatra, the valley of the Irrawady in Burma, and from China. One such variety was collected by Stonor (No. 17), though he commented as follows: "Evidently not quite a pure strain." The ear-to-row test of this collection showed more plant-to-plant variation than did Stonor's other collections among the Naga. In it the distinctive characters of the rest of the collection are less strongly developed. It grew more quickly, had more pronounced plant color and colored silks, it had coarse tassels, large ears with white kernels conspicuously capped with soft starch, and was the earliest of anything in the collection. It showed Assamese tendencies in its somewhat included tassel. It probably represents a fairly recent mixture between Assamese maize and one of those Caribbean types which were spread so widely around the world by the Spanish and the Portugese.

II—*Early Slender*: In its slender stem, long slender leaves, and most pronounced spathe at flowering time, this variety was very similar to VI. It differed in being the earliest of the distinctive varieties and in the morphology of the mature tassel. Although the tassel branches were completely pendent when they first appeared and even after they began to shed pollen they eventually stiffened to produce a tassel more like broom-corn than any other known variety of maize. The long, slender, wiry branches became stiffly distended when mature, and the small glumes (5–6 mm. long) were quite closely appressed. As in many of the varieties with short upper internodes, the auricle of the uppermost leaf was developed into a conspicuous tuft of long white hairs. Though to casual observation this variety seemed to be completely green, careful examination at the base of the plant showed a faint flush of color.

III—*Late Upright*: The leaves of this type were dark green, were held crisply erect until after the tassel appeared, and were twisted, usually one complete revolution and sometimes more. The plants had many short internodes and grew and

TABLE I
CHARACTERISTICS OF NAGA VARIETIES

Type	Stonor No.	C.I.T. No. 1948	Row Number	Kernel size in mm.	Kernel shape	Midcob width in mm.	Pith diam. in mm.	Base color	Tassel inclusion	Pendent tassel	Season	Chromosome knob number	Kernel color	Number of ears
I—Caribbean	17	1088	14	Large	Flat	26	11	+	Faint	Slight	Early		White	1
II—Early Slender	13	1084	14	Medium	Square	20	6	—	Strong	Medium	Early		Lt. yellow	1
III—Late Upright	5	1076	14	Small	Sphere	20	7	0	Strong	Strong	Early		Dull blue	4
	8	1079	20	Small	Sphere	22	11	0	Faint	Strong	Very late		Purplish	3
	9	1080	20	Small	Sphere	22	8	0			Very late	4	Dull blue	
	10	1081	16	Small	Sphere	19	7	0	Faint		Late	5-7	Dull blue	
	14	1085	14	Large	Subsphere	18	12	+			Late		Red-purple	
IV—Early Upright	6	1077	10	Very small	Sphere	18	3	+	Strong	Medium	Early		Red	4
V—Late Sidewise	11	1082	16	Small	Sphere	23	7	—	Strong		Very late	4-6	Lt. yellow	3
	12	1083	12	Small	Sphere	18	4	+	Strong		Very late	2	Or. yellow	4
	18	1089	14	Small	Sphere	19	4	+	Strong		Very late	4-5	Lt. yellow	4
VI—Drooping Waxy	16	1087	16	Small	Sphere	30	7	+	Strong	Strong	Mid-season		Ivory	2

developed slowly. The internode pattern of a typical plant is shown in fig. 1. The kernels are small, with a dull, purplish blue aleurone and are used as a popcorn (see Stonor's notes). Similar popcorns (as well as the actual popped kernels) have been received from correspondents in Siam. Stonor's different collections made among various Naga tribes were almost identical in growth type aside from one or two obviously out-crossed individuals. In their small kernels, upright twisted leaves, large number of ears, and pedicel and cob anatomy, this type resembles certain ancient popcorns of South America. Ears and popped kernels have been obtained from various graves and trash-heaps in coastal Peru and Chile (Anderson, 1947), and through the kindness of Dr. Paul Weatherwax a living example of such a popcorn was grown from one of Parodi's collections in Argentina. Since Ica times (the Ica preceded the more widely known Inca) these kinds of small-kernelled popcorns have been rare. At earlier times they were apparently the prevailing type along the coast of Peru and Chile and have been recovered from graves in the Argentine. A somewhat similar popcorn, of unknown origin, is sometimes grown in the United States in spite of its long season and small ears, because of its high quality. Though it has been extensively confused with the early-seasoned "Tom Thumb," its proper name is apparently "Ladyfinger," by which name it was first called in the United States at least a century ago (Emmons, 1849).

The tassels of Late Upright plants exhibited little or no condensation and from slight to pronounced multiplication (Cutler, 1946). The central spikes were prevailingly in whorls of three. Most of the plants grew four good ears with partly developed nubbins at lower nodes. Collection Nos. 5, 8, and 10 showed no base color (in other words they were like 'aa' plants) and No. 14 which showed base color had larger and redder kernels and may well have been derived from a cross between a typical Late Upright and some other sort of maize. One cob of No. 8 was examined by Lenz (1948) and is figured by him, plate 38, fig. 5. It has the longest, slenderest pedicel ever reported for any variety of maize.

IV—*Early Upright*: This one collection (No. 6) was in every way like the Late Uprights except that it was earlier, had red seeds, and pronounced base color.

V—*Late Sidewise*: Both in Assam and in the United States this variety in the vegetative stage looks unlike anything previously reported for *Zea Mays*. The leaves and especially the culms are bluish-green with a distinct bloom. The tillers are practically horizontal during the first month or so of their development. On both tillers and main culm the internodes are very short, and even in the mature plants few ever exceed 10 cm. in length. Most agronomists, seeing the plants before they had tasseled out, would have wondered if they were some kind of sorghum. Base color varied from very faint to strong, and the leaves, even early in development, stood out at right angles to the culm. The ears were long and slender with small yellowish kernels. The large number of internodes (30 or more

per plant) was evidently not a response to a longer day length, since similar results were obtained in Shillong and since there were prop-roots at only one or two of the lower nodes. (In tropical maize grown in the United States there may be prop-roots on 10 or more nodes as one result of the change in length of day.)

VI—*Drooping Waxy*: Up to flowering time this variety was much like II except for the later season and consequent higher number of leaves. It had the same slender culm, slender green leaves, and, if possible, an even more highly developed spathe from within which the slender tassel branches drooped straight downward. Even at the end of the season, both in California and Assam, the tassel, though arching horizontally, was still quite pendent and much more extreme than any tendency of this sort in South American maize. All the plants of this variety had waxy pollen, and an analysis of the kernels at the Northern Regional Laboratory at Peoria, Ill., bore out this diagnosis. Stonor reported the young ears as being outstandingly sweet, and, like much of the waxy maize in the Orient, this is probably a specialized type used for green corn. Waxy maize is cultivated in the vicinity of Chungking, China, as a table corn, and Kuleshov's monograph (1928) illustrates the same pendent tassel in waxy varieties from various parts of Asia.

To summarize: These remote Asiatic aborigines cultivate a number of exceptionally well-differentiated varieties of maize. The following unusual characters typify one or more of these varieties:

Uniformly green leaves, culms, silks, and anthers.

Slender, pendent tassel branches.

Straw-yellow endosperm, dull bluish-red aleurone.

Small, isodiametrical kernels.

Many short internodes, lack of vegetative vigor.

Upright, twisted tassel branches, short silks.

Tassel included in upper leaves at flowering time; leaves immediately below it falsely monostichous, forming a sort of spathe; tassel not completely exerted even when mature.

Waxy pollen and endosperm.

As we shall demonstrate below, this complex of characteristics is widely distributed in the back corners of Asia. It would be of primary significance to know where it is most closely approached in the New World. Certainly nothing like it is known from Mexico, Guatemala, or other parts of Central America. The only United States variety showing any of these characteristics is "Ladyfinger" popcorn, a variety of unknown origin which has been in this country for at least a century (Emmons, 1849).

In South America this complex of characters is rare, and most of the collections and published descriptions demonstrate radically different types of maize throughout that continent. However, a popcorn collected at Chiu Chiu, a remote oasis in

the Atacama desert of northern Chile, by Carl and Jonathan Sauer, has a number of features in common with these Oriental varieties (Anderson, 1943). Furthermore, as mentioned above, an indigenous popcorn collected in Argentina by Parodi, shows many of these same characters. A photograph by Jonathan Sauer of still another variety from Chiu Chiu, Chile, shows the multiple ears, the short silks, and the short upper internodes of the oriental varieties. In a collection of native corns from the Bolivian edge of the eastern lowlands, kindly turned over to me by Dr. H. C. Cutler, there were several plants which had the green plant color, pendent tassels, multiple ears, and spathe-like upper leaves of the Oriental varieties. Dr. F. C. Brieger informs me that he noted some of these same characteristics in other collections from these valleys. Insofar as one can judge from characters of the mature ear, a fairly similar set of varieties was once common on the west coast of South America. All the collections of early prehistoric maize from that area (and the museum material is so rich that it has not yet been possible to measure and record all of them) shows a small-cobbed variety with isodiametrical kernels, much of it apparently a popcorn, since the prehistorically popped kernels are known from a number of sites. This type, uniform in the lower archaeological levels, became gradually more variable and was supplanted by larger-kernelled types similar to modern Andean maize, when the Incas extended their influence down to the coast in times preceding the Inca domination.

In the Orient, on the other hand, similar varieties are widely, though very spottily, distributed. They are associated with the most primitive cultures in southeastern Asia, principally with the Tibeto-Burmans and allied peoples. In 1909 G. N. Collins published an exhaustive account of a variety of maize with a waxy endosperm which had been collected in China. In 1920 the same author, in a short communication, reported that waxy maize and other curious varieties had been obtained from the hill tribes of Upper Burma. Collins' description of waxy maize would apply equally well to most of the Naga varieties:

While in only about 25 per cent of the plants were the upper leaf blades completely monostichous, all of them showed a tendency in this direction. This one-ranked appearance is brought about by a twisting of the leaf sheaths, the actual insertion of the leaves being opposite as in all grasses. In addition to the unusual position of the leaves the blades of the upper nodes were erect instead of spreading or dropping as in other varieties The internodes on the upper part of the plant were also much shortened, so that the tassel was not carried up, as in other varieties (*loc. cit.*, p. 8).

His description (*loc. cit.*, p. 13) of the aleurone color is also applicable to many of the Naga collections:

The color of the aleurone layer was distinct from anything that has been observed in other varieties. It varied greatly in intensity. In rare cases it approached the bluish black of our common "black" varieties, but for the most part varied from a dull ruby to maroon. The color was usually confined to the top of the seed, fading out toward the base.

Under Vavilov the Russians made a comprehensive survey of Oriental maize which was reported upon by Kuleshov in 1928. It is extensively illustrated and accompanied by a summary in English (pp. 371-374). It demonstrates that

varieties similar to those described from the Naga country are widespread in central Asia from Persia and Turkestan to Tibet and Siberia. Figure 6, a variety from Persia, shows the characteristic short silks described by Collins and fig. 11 (3-6) shows tassels covered by a spathe of leaves in Persian and Turkestan varieties. Extremely pendent tassels from a number of points are described and illustrated. On pages 373-374 Kuleshov summarizes his morphological evidence.

Asiatic maize shows a series of characters which are either unknown or very rare in American¹ maize. These characters manifest themselves in connection with a definite area, sometimes a very large one. Thus the waxy endosperm is spread from 5 to 45° North lat.; the short plant habit is peculiar to the vast expanse of Central Asia; panicles covered by the upper leaves and silks hiding in the axil of the leaf are met with in specimens from eastern Asia to Transcaucasia, etc.

The question of the introduction of maize into the Orient was gone into exhaustively by B. Laufer (1909). He came unequivocally to the conclusion that it was not introduced into China from the coast like other American crops but spread overland via Tibet. He was an accomplished linguist and bibliographer but without botanical training and had had to take the word of the botanists of his day that maize in the Orient was morphologically not different from maize in the New World. With this as a premise he could have come only to the conclusion he finally reached: that maize somehow got to Indian ports at an early post-Columbian date and spread overland via various primitive peoples to China. He quotes no botanical authorities for the morphological equivalence of Asiatic and New World maize, merely stating (footnote p. 224) his premise "If maize were indigenous to Asia, we should expect to find there either a wild form, from which the cultivated species are derived, or the Asiatic species to be differentiated from that of America, neither of which is found." Had the botanists of his day studied Oriental maize in even a cursory fashion they would have found that Asiatic maize is indeed "differentiated from that of America," most particularly in that very area between China and India which Laufer decided must have been the route by which the crop eventually reached China. His monograph is a mine of information as to the frequency of maize among these various primitive peoples and the role it plays in their economy:

In the remarkable culture of the small mountainous tribe of the Lepcha in Sikkim, a people closely related in language to the Tibetans, maize plays a significant role, and it is surprising to note what a rich terminology they have developed with regard to its economy. There are four words for maize, two for the flowers of maize; and no less than eighteen varieties, by means of attributes are distinguished. Further the head of maize has several names according to its growth. There is a special expression for the young head when first appearing, for the head when seed commences to appear, when the grain begins to get a little larger, when the grain begins to get a little firm, when the grain has acquired firmness and for the head when ripe! [loc. cit., p. 242] It is interesting to note that among all the so-called aboriginal tribes of western and southern China, maize forms the favorite and principal food and is more highly appreciated by these tribes than by the Chinese. [loc. cit., p. 244].

¹It should be emphasized that Kuleshov (1930) produced a monograph on the collections of maize made by Vavilov and his collaborators in Central and South America and was probably as familiar with the morphology of New World maize, as a whole, as any other investigator.

Laufer quotes (*loc. cit.*, p. 245) B. C. Henry who says that in China maize "is now very extensively cultivated by the Chinese, but especially by the aboriginal peoples, among whom it seems to be almost as great a favorite as among the American Indians. It forms a main portion of the sustenance of both the aborigines in the north-western corner of Kwantung and of those in Hainan."

Through the courtesy of Dr. Ian Khambanonda it was possible to import a sample of a popcorn from Siam. It has violet-blue kernels similar to those of the Assamese varieties received from Stonor. Dr. T. W. Whitaker kindly grew a few plants of it for me at the U. S. Dept. Agr. Vegetable Breeding Laboratory at La Jolla, California. In its long season, upright leaves, slender tassel branches, short internodes, and large number of ears it closely resembled the Assamese popcorns. Popped kernels were also forwarded from Siam but Dr. Khambanonda was unable to supply very much detailed information because maize in Siam is grown principally by the aboriginal hill-tribes, seldom by the Siamese.

To summarize: A number of distinctive maize varieties are grown in the remotest parts of southeastern Asia, particularly by the aborigines of various hill tribes. Without exception it is more common among these primitive folk than among their civilized neighbors. In China it is more common and more appreciated among the aboriginal tribes of western and southern China than by the Chinese (*Laufer, loc. cit.*). Dr. Khambanonda testifies to its almost exclusive cultivation in Siam by the aborigines. Interviews with Ko Ko Lay, now an exchange scholar from Burma, have produced similar testimony for Burma. Dr. Pierre Larroque, the former maize breeder for Indo-China, tells me that among the primitive Meo, ethnologically related to the Tibetans, it is very commonly grown and that on the Yunnan border it seems almost to run wild. Mr. Stonor, the author of the first section of this paper, having been transferred to New Guinea, informs me that although it is either unknown or very recent along the coast, it is found among the primitive peoples of the interior. Its importance among the Lepcha of Sikkim and the aboriginal Li of the Island of Hainan has already been alluded to.

That maize could in post-Columbian times have spread to each of these various hinterlands without entering into the economies of the more civilized people who would have handed it on almost passes belief. Had it spread only to the Naga, one would have wondered what special circumstances caused its adoption by a people so remote that one ethnographer describes them as having lived for thousands of years "in these hills, as on some happy island, almost untouched by the waves of civilization which from time to time have surged through the plains of Assam and the valleys of Upper Burma. Ancient cultures which were once spread over great parts of southeastern Asia and which in most countries had finally to give way before the higher Indian and Chinese civilizations have been preserved here in a comparatively untouched form, and allow us to observe with our own eyes, early types

of human culture" (von Fürer-Haimendorf, 1939). Furthermore, when we examine the maize of these people it is not the dominant world crop of Central and North America. It is relatively unproductive and with less vigor than other known types of maize. To believe that in post-Columbian times maize could have penetrated not only to the Naga but to the hill tribes of Upper Burma, and of Siam, to the Lolo in central Asia, to the aborigines of Hainan, to the hill peoples of Sikkim, and to the interior of New Guinea, in each case passing over the more civilized peoples along the coast is beyond credulity. To have these conservative people somehow learning to use maize as a popcorn and as a green corn and as a cereal for brewing, to have them growing types of maize which are similar to each other yet rare or unknown in the New World puts the burden of proof on any one who would ascribe all this development to separate post-Columbian acquisitions.

It seems more likely that there have been at least two major movements of maize in Asia. The latter in early post-Columbian times brought what is essentially a Caribbean type of maize to the Philippines and to many countries actively colonized by the Europeans. Back in the hills, however, are much more primitive types, unaggressive, not particularly productive, grown by conservative people. If one asks why they did not spread more the answer is that they did spread in Asia from Persia to Sumatra and New Guinea, which is virtually as far as the Asiatic *Sorghum* (which was their companion crop) has been carried.

The general evidence for the main kinds of maize in South America and in southeast Asia is crudely and diagrammatically summarized in fig. 2. The letters A, B, and C represent three of the major races which make up *Zea Mays*. Letters within parentheses indicate that a particular type is present but is relatively uncommon. Each of these major races has a core of morphological characters in common in spite of great variation from variety to variety within the race (Anderson and Cutler, 1942). A represents the small-kernelled types we have just been describing and mixtures with them. In South America they are found today either as rare native popcorns or as one of various primitive tendencies in the highly heterozygous maize of the eastern river basins (Cutler, 1946). In Asia they are practically confined to hill areas and in the most isolated are the only type. In western South America, where we have stratigraphic archaeological evidence, we know that race A was for centuries the only type of maize. B, in fig. 2, represents the distinctive large-seeded frequently large-cobbed types of the Andean region, which are practically exclusive at higher altitudes, which have dominated (at least in mixtures) the west coast ever since prehistoric times (late Ica) and which are one of the elements in the maize of the Amazon basin. Such types are apparently unknown in Asia, a most significant fact. C stands for the widely adaptable types of the Caribbean basin which spread so rapidly and extensively around the world in post-Columbian times.

This diagram is factual and though some of these facts are matters of judgment; with other types of maize it has already proved possible to make objective records of such racial differences (Anderson, 1944; Brown and Anderson, 1947; and Anderson, 1947), thus taking such questions out of the realm of acrimonious quibbling. The interpretation of these facts is quite another matter. The facts are in themselves fantastic; any satisfying hypothesis must border on the miraculous. One fact seems to be clear. Race C, which we know to be archaeologically post-Columbian in South America, was widely spread in post-Columbian times. If we therefore remove C from consideration, the problem to be solved is how could race A get to a number of isolated hill areas in Asia without anywhere leaving a very definite record along the coast of Asia? If, for the sake of argument, we grant that it might somehow have spread there from the Upper Amazon in post-Columbian time, who brought it and how? Was there somewhere in the New World a reservoir of various A varieties which has since disappeared? Could all the A varieties in Asia have differentiated themselves in all these backward areas into a set of unique but similar varieties under the stimulus of a new environment? These are possibilities but they certainly seem fantastic.

If we admit (with a growing minority of archaeologists) the possibility of trans-Pacific contact in very early pre-Columbian times, then race A might have crossed the Pacific at an early date when maize was still an unaggressive little popcorn, to be carried across the Pacific again when the dominant world crop which we now know had been developed in the New World. As to which way maize made its first crossing, whether from Asia to the New World, or *vice versa*, the facts of fig. 2 do not even suggest an hypothesis. From the generally accepted facts as to the relationships of maize a good case could be made out for either Asia

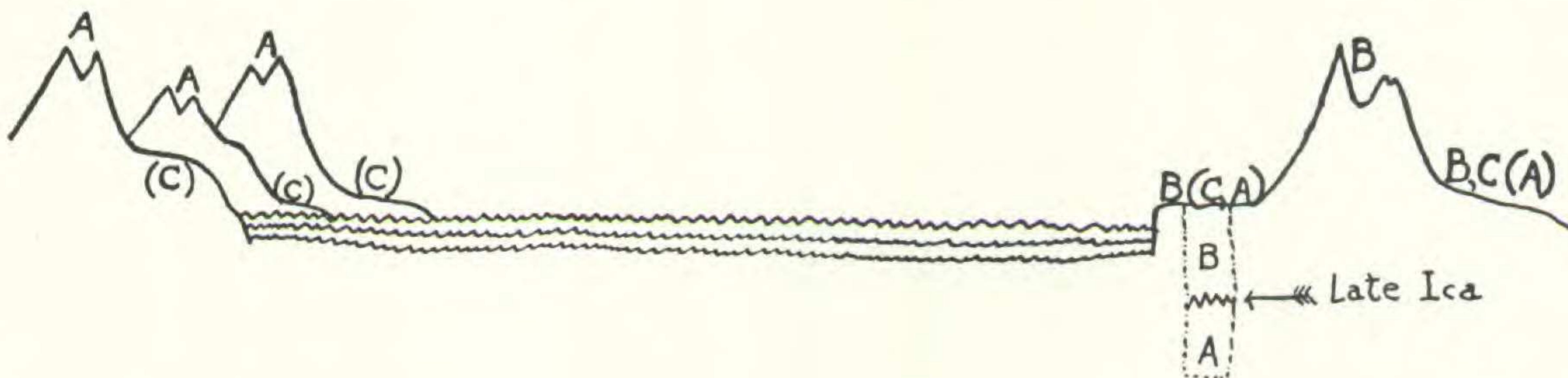


Fig. 2. Distribution of the major races of maize in South America and in Asia. Very diagrammatic, A, B, and C represent three of the main kinds of maize, each consisting of various sub-races and innumerable varieties. Though these races may intermingle, each has its own core of correlated tendencies: Race A, archaeological and Asiatic—small ears, large glumes, subspherical seeds, short internodes, drooping and included tassel, green plant color; Race B, Andean—large kernels, pineapple-shaped ears, large cobs, strong plant color; Race C, tripsacoid—long ears, stiff tassel, bony cob. Letters in parentheses indicate areas where a particular race is known only in mixtures with other races. In the Orient race C is represented in "Caribbean Flints" a mixture of C and other races. Asia is diagrammed to the left of the figure, South America to the right, with the Pacific in between. For western South America there is extensive archaeological evidence, some of it stratigraphic, which allows us to establish a sequence of maize types from A to B.

or the New World as a primary center. There can be no doubt that the New World was certainly the secondary center, or rather a whole set of secondary centers.

The physical possibilities of transfer by the early Polynesians are much more likely than most botanists are aware. These early people were skilled navigators who could deliberately set out for Hawaii from Samoa and arrive at Hawaii. Furthermore, they were skilled cultivators who carried vegetatively propagated varieties of various crops to many of the islands of the Pacific (Buck, 1938). Getting the improved taro and bread-fruit to Hawaii (which they are known to have done) would have called for more skill as navigators and cultivators than to have taken maize from New Guinea to Peru.

Nor would maize have been exceptional among cultivated plants had it been taken across the Pacific. It is known that the gourd crossed the Pacific in very early pre-Columbian times and it is admitted by most authorities that the cultivated sweet-potato originated in the New World but spread in pre-Columbian times to Polynesia and even as far as New Zealand. The sword bean (*Canavalia*), widely cultivated throughout the Pacific and always considered to be of Old World origin, is now known from prehistoric sites along the coasts of both South America and Mexico.

The hypothesis here suggested as to the origin and developments of maize is paralleled almost exactly by the conclusions concerning cotton reached after long cooperative research by the British cotton experts (Hutchinson, Silow & Stephens, 1947). In the case of cotton, polyploidy operated to keep certain mixtures of old and New World germ-plasm from losing their identity in the mixture, thus making the story quicker to untangle and more difficult to controvert.

For many minor domesticated plants, the rather complete neglect of cultivated plants and weeds by taxonomists leaves any general discussion of the problem at the stage of mere guesswork. Neither the cotton story nor that of maize could be put together until a beginning had been made at the fiendishly difficult problem of classifying and cataloguing their various cultivated varieties. Both Amaranths and Chenopodiums are cultivated by the hill peoples of Asia and of the New World as cereal crops, pot-herbs, ornamentals, magic plants, and food colors. Not until these groups have been meticulously collected and monographed (the cultivated strains, the weeds, and the genuinely wild entities) can we be in a position to discuss the evidence. Similar careful studies are needed of the various strains of *Bixa Orellana*, of Job's tears (*Coix*), of *Pachyrhizus*, all of which are widely distributed in both the Old World and the New. There is little really critical taxonomic evidence on origin and diffusion for any of these groups at present. It is disappointing to find, half-way through the twentieth century, that our botanical evidence is not yet at a stage where such fundamental questions can be authoritatively discussed. For the plants most directly associated with man, the cultivated plants

and weeds, aside from a few collections by such pioneers as Ames, L. H. Bailey, and Merrill, we do not have the specimens let alone the critical studies. The average botanical collector is so intrigued by cloud forests and river jungles that he does not even think about the more difficult problems posed by the vegetation of dump-heaps, clearings, and cultivated fields.

For maize itself, two facts suggest how complicated a story may be involved: (1). The relationship of *Sorghum*, Assamese maize, and prehistoric North American maize. Whatever the explanation, it is clear that the maize of Assam is more like *Sorghum* in a number of different ways than is any other modern maize as yet examined in detail. Whatever the explanation, it is also clear that the earliest prehistoric maize cob described from Bat Cave, New Mexico, by Mangelsdorf and Smith (1949) is even more *Sorghum*-like in the details of its inflorescence, while cobs from the upper layers of the same cave are as radically un-*Sorghum*-like as it is possible for maize inflorescences to be. It may be that maize and *Sorghum* have had a parallel evolution in the Orient under the stimulus of a similar set of environments. It may be that they are related in some way; it is known that they have the same chromosome number. Whatever the explanation, the whole story must be a complicated one. (2). Much of the maize of Central and North America has knobs on its chromosomes, a character which Mangelsdorf and Reeves ascribed (1939) to introgression from *Tripsacum*, a New World grass. Much of the maize of South America is knobless. The maize of Assam has only a few knobs but they are frequently quite large and they tend to occur at positions and in combinations which are either rare or unknown in New World maize. Here again a complicated history of exchange and evolution is suggested.

Only one thing is certain. We must have extensive and critical collections of Oriental maize if we are to understand *Zea Mays* and utilize it most effectively. We need this information for practical and theoretical purposes. Kuleshov (loc. cit.) describes and illustrates dwarf, drought-resistant types from Persia. Larroque tells (personal communication) of a small-grained sort raised in Indo-China for chicken feed which germinates effectively in the soaking wet soil of rice paddies. More important and far-reaching is the need for such collections if we are to understand the history of maize. Along with *Drosophila* and *Neurospora*, the science of Genetics is built on work with *Zea Mays*. The brilliant work of Stadler and of McClintock, for instance, might have quite different implications for the fundamental nature of evolution or for the protein chemistry of the germ-plasm, depending upon the actual history of the germ-plasm which they have been using, the germ-plasm of *Zea Mays*. Certainly we cannot even discuss the probable history of *Zea Mays* in an intelligent fashion until we have at least an approximate notion of what varieties of maize are being grown by the Lolo in central Asia, by the hill tribes of Burma, Siam, and Indo-China, by the aboriginal remnant in Hainan and Formosa, and in the isolated interior of New Guinea.

GENERAL SUMMARY

Part I:—

1. The various hill tribes of Assam and neighboring regions are enumerated and their relationships to each other and to outside peoples are briefly described. In general, these tribal peoples grow their own food, weave their own clothing, and regulate their own affairs by tribal law. They have no writing and their religion is animistic.

2. The varieties and uses of maize are enumerated tribe by tribe. It is used for human food, particularly when immature (i.e., as "green corn"), for beer-making, as popcorn, and for pig-feeding. Its importance varies from tribe to tribe but, along with the cereal forms of Job's-tears (*Coix*) and millet (*Sorghum*), it is traditionally one of the ancient foods of the region.

3. It is usually grown in lines or patches or as single plants among other cereal crops. In spite of this practice, the varieties are kept remarkably pure, even when five or six distinct types are grown by a single village.

4. The wide distribution in the area, the traditions and positive statements of the peoples themselves, the existence of tribal names, and the place of maize in their religions all point to a long history in this region, going back for centuries at least and most probably antedating rice culture there.

Part II:—

1. The assembling of all the evidence on the morphology of these Assamese varieties was a complicated affair, because their growing season is long and because the importation of maize from southeastern Asia is necessarily restricted¹. They were collected directly from the Naga and grown in duplicate in Assam and California. A set of the original ears was photographed on the ear in London, and plants from ear-to-row tests were photographed in California and in Assam. Pachytene smears were made of many of the cultures, and a few of the original cobs were studied in celloidin section by Lenz.

2. There are considerable differences between the Assamese varieties (most of which are remarkably uniform within the variety). As a whole they tend to have: slight or no plant color, many short internodes, semi-included tassels, spathe-like upper leaves, pendent tassel branches, several small ears, long slender leaves, short silks, dull aleurone colors, small subspherical kernels. They are outstanding, both in Assam and in this country, for their lack of vigor.

3. This complex of characters is unknown in Mexico and Central America. In South America it is approached only in mixtures from the eastern rivers and in certain primitive popcorns. In prehistoric times, varieties with similar cobs and kernels were the only type of maize along the west coast of South America for a very long period.

¹Due to the presence of two of the world's worst maize diseases in this area, in itself a significant fact.

4. The distribution of these and similar varieties in the Orient is reviewed. They are widely though spottily distributed from Persia and Turkestan to Tibet and the Island of Hainan, nearly always among primitive and conservative peoples.

5. It is concluded that there have been at least two major movements of maize in Asia. The later one, in early post-Columbian times, brought what is essentially a Caribbean type of maize to the Philippines and to many of the countries actively colonized by the Europeans. Back in the hills, however, are more primitive types whose progenitors must have crossed the Pacific in pre-Columbian times, though in which direction (or directions) the evidence does not indicate.

6. The possibility of trans-Pacific transfer of a primitive and unaggressive race of maize by early Polynesians is discussed. It is shown to parallel the conclusions reached by the most recent workers on cotton. For the study of such problems, the imperative need of more critical taxonomic evidence on cultivated plants and weeds is discussed and illustrated by examples.

7. It is concluded that maize has had a long and complicated history. As a dominant crop it certainly developed in the New World. As a primitive, relatively unproductive crop, utilized for brewing, for popping, and for green corn, it is almost universal among the primitive peoples of central and southeastern Asia. Presumably it must either have originated in Asia or have been taken there in pre-Columbian times. Before we can discuss the history and origin of maize intelligently we shall need an approximate survey of the kinds of maize being grown by these peoples.

BIBLIOGRAPHY

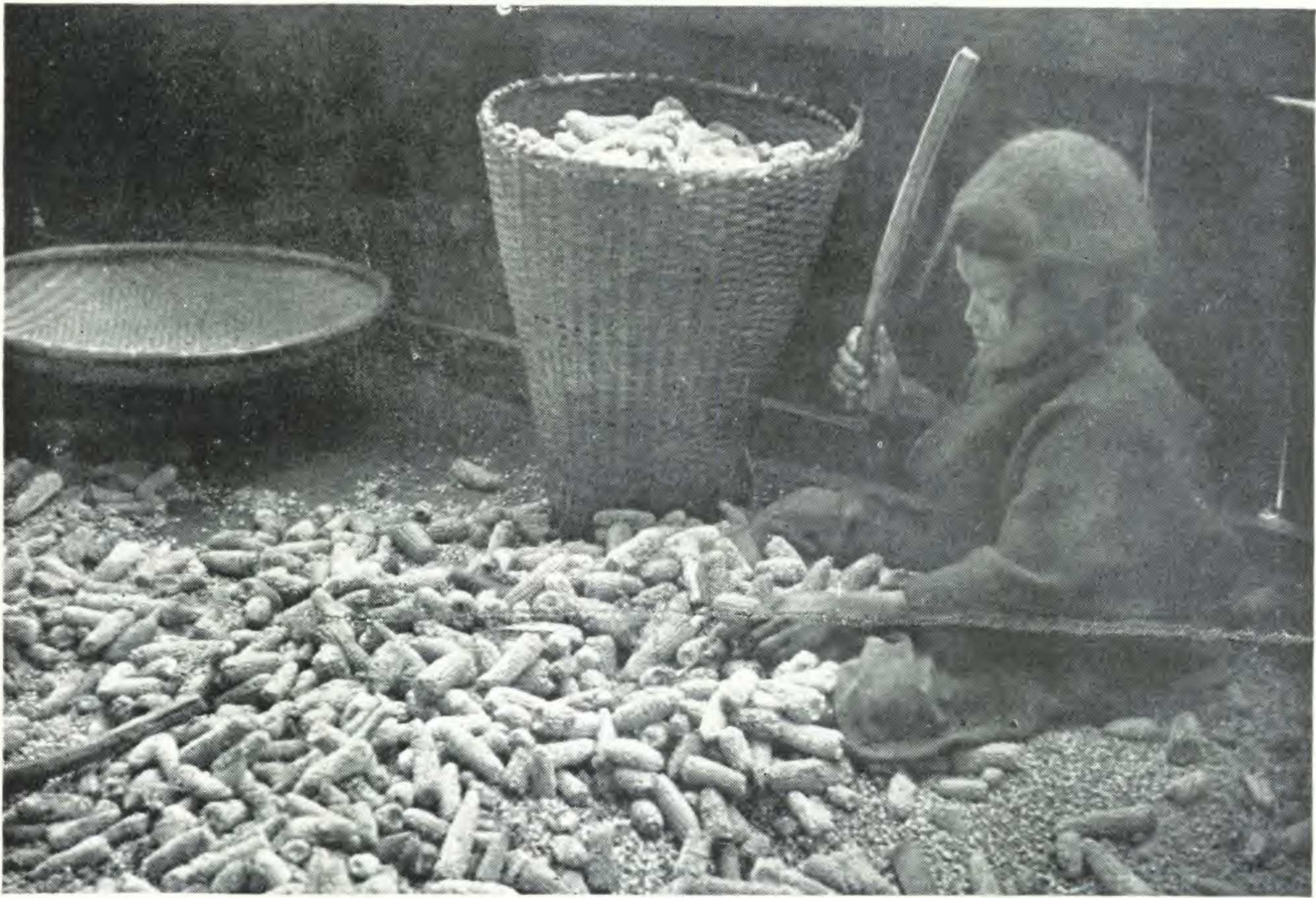
- Anderson, Edgar (1943). A variety of maize from the Río Loa. *Ann. Mo. Bot. Gard.* **30**:469-474.
 ———, (1944). Maíz reventador. *Ibid.* **31**:301-312.
 ———, (1946). Maize in Mexico. *Ibid.* **33**:147-247.
 ———, (1947). Corn before Columbus. 24 pp. Des Moines, Ia.
 ———, and William L. Brown (1947). The northern flint corns. *Ann. Mo. Bot. Gard.* **34**:1-22.
pl. 1-6.
 ———, and H. C. Cutler (1942). Races of *Zea Mays*. I. Their recognition and classification. *Ibid.* **29**:69-86.
 Buck, Peter H. (1938). Vikings of the Sunrise. New York.
 Collins, G. N. (1909). A new type of Indian corn from China. U. S. Dept. Agr. Bur. Plant Ind. Bull. 161:1-30, *pl.* 1-2.
 ———, (1920). Waxy maize from Upper Burma. *Science, N. S.* **52**:48-51.
 Cutler, Hugh C. (1946). Races of maize in South America. *Bot. Mus. Leafl. Harv. Univ.* **12**:257-291.
 Emmons, Ebenezer (1849). Agriculture of New York **2**:263-265. *Nat. Hist. N. Y. Pt. V, Vol. 2.*
 Von Fürer-Haimendorf, Cristoph. (1939). The Naked Nagas. 243 pp. London.
 Hutchinson, J. B., R. A. Silow, and S. G. Stephens (1947). The evolution of *Gossypium*. 160 pp. Oxford Univ. Press.
 Kuleshov, N. N. (1928). Some peculiarities in the maize of Asia. *Bull. Appl. Bot. and Pl. Breed.* **19**:325-374.
 ———, (1929). The geographical distribution of the varietal diversity of maize in the world. *Ibid.* **20**:506-509.
 ———, (1930). The maize of Mexico, Guatemala, Cuba, Panama, and Colombia. *Ibid. Suppl.* **47**:492-504.
 Laufer, B. (1907). The introduction of maize into eastern Asia. *Cong. Int. des Americanistes.* pp. 223-253. Quebec.

- Lenz, L. W. (1948). Comparative histology of the female inflorescence of *Zea Mays* L. *Ann. Mo. Bot. Gard.* **35**:353-376.
- Mangelsdorf, Paul C., and R. G. Reeves (1939). The origin of Indian corn and its relatives. *Texas Agr. Exp. Sta. Bull.* 574.
- , and C. Earl Smith, Jr. (1949). New archaeological evidence on evolution in maize. *Bot. Mus. Leafl. Harv. Univ.* **13**:213-247.
- Merrill, E. D. (1941). Man's influence on the vegetation of Polynesia with special reference to introduced species. *Proc. Sixth Pacific Cong.* **4**:629-639.

EXPLANATION OF PLATE

PLATE 18

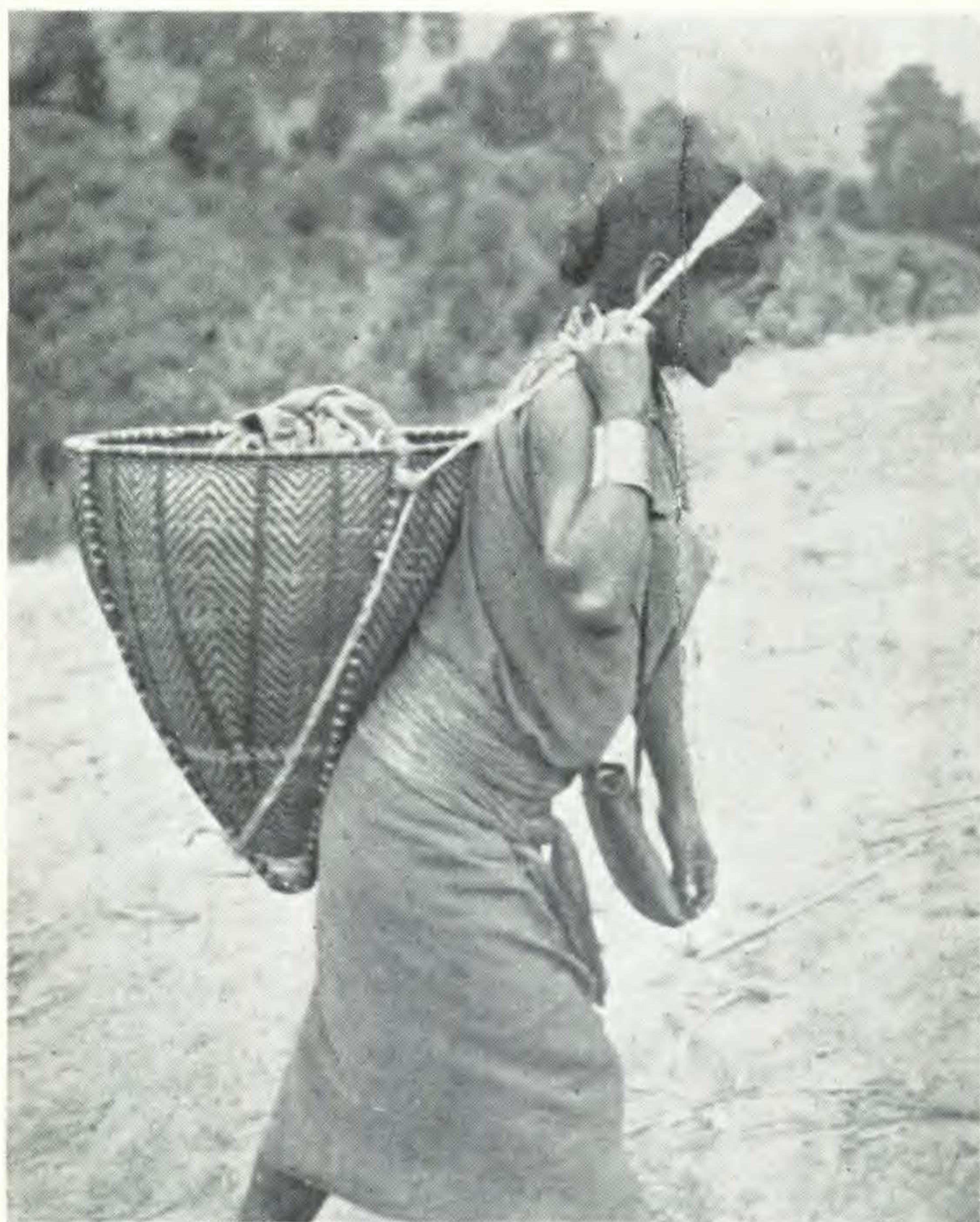
- Fig. 1. Monba tribe. Threshing maize, Dirang village. (November, 1946).
- Fig. 2. Monba tribe. Maize stacked for ripening, Pakung village. (November, 1948).



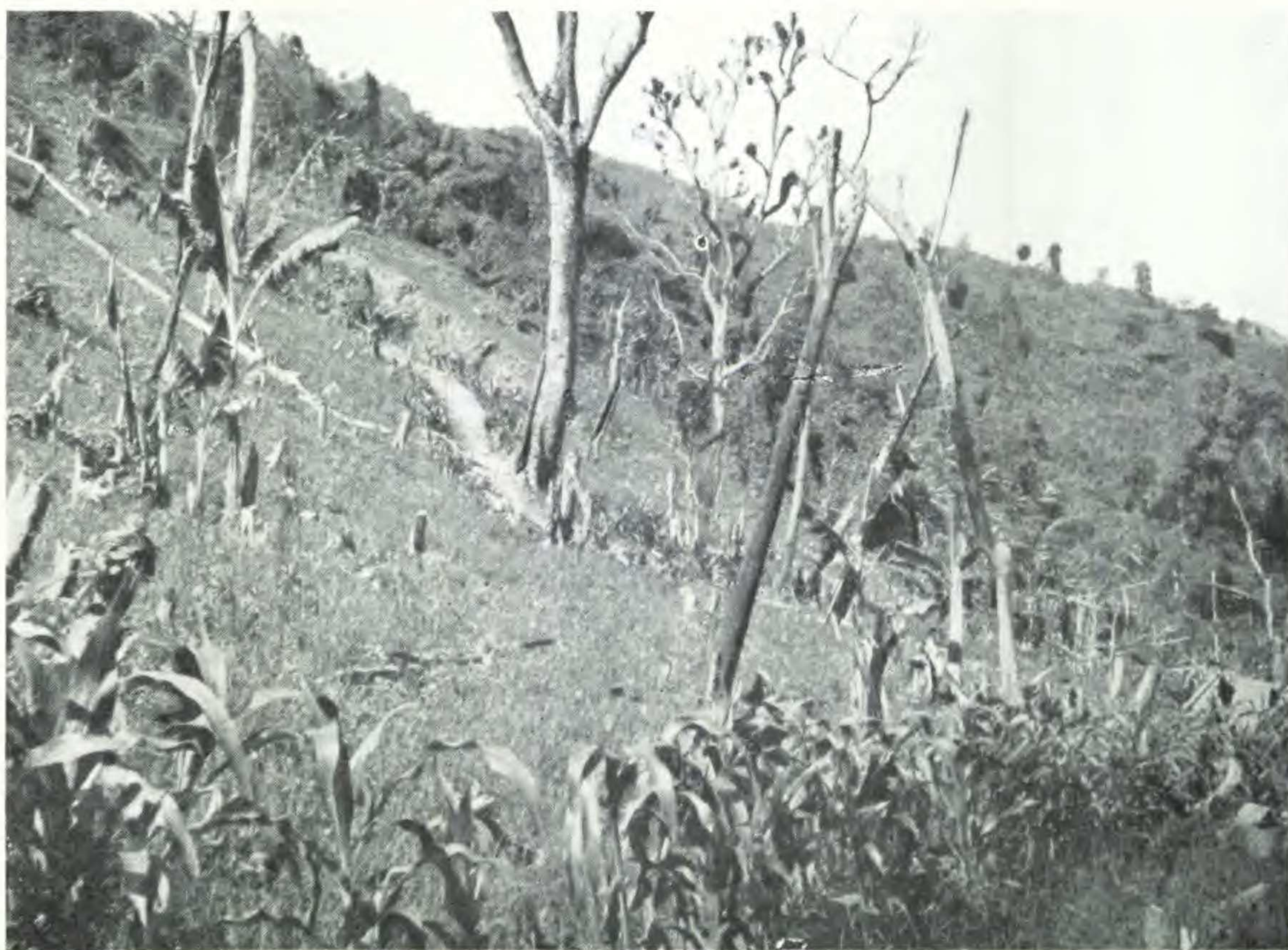
EXPLANATION OF PLATE

PLATE 19

- Fig. 1. Eastern Dafla tripe. Carrying in the maize from the fields. (November, 1946).
- Fig. 2. Lhota Naga tribe. Corner of a "jhum" field, with lines of maize growing among the rice. (May, 1947).



1



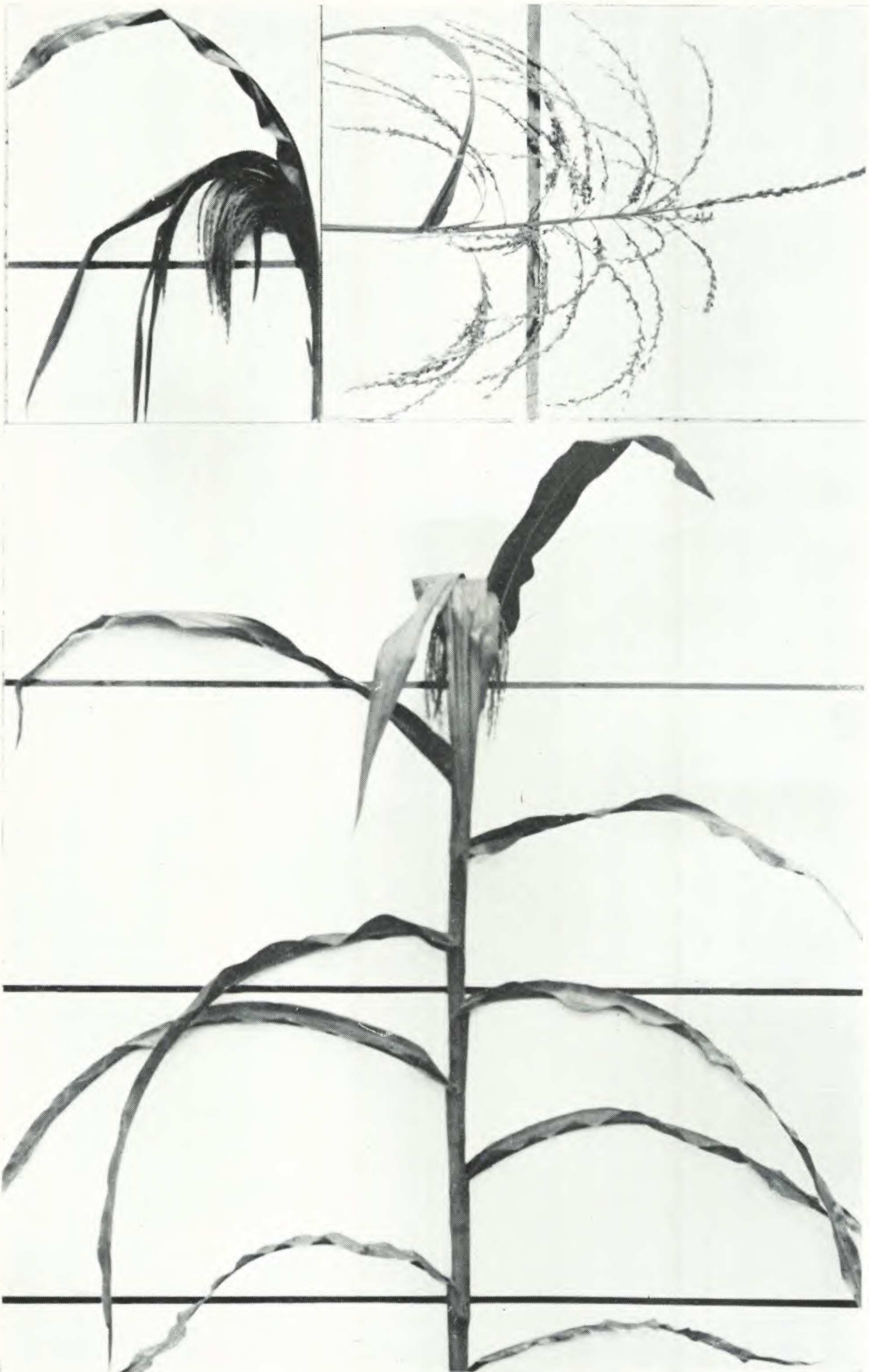
2

STONOR & ANDERSON—MAIZE OF ASSAM

EXPLANATION OF PLATE

PLATE 20

Three views of Stonor No. 13 (Early Slender). Scale indicated by the lines in the background which were originally spaced at 50 cms. Below: habit of plant when tassel began to shed pollen. Note the "spathe" of upper leaves which is directed towards the camera. Upper left: the same, viewed from the side. Upper right: close-up of tassel after pollen shedding was complete. Note proximity of upper leaf to base of tassel. Photographs courtesy of California Institute of Technology.

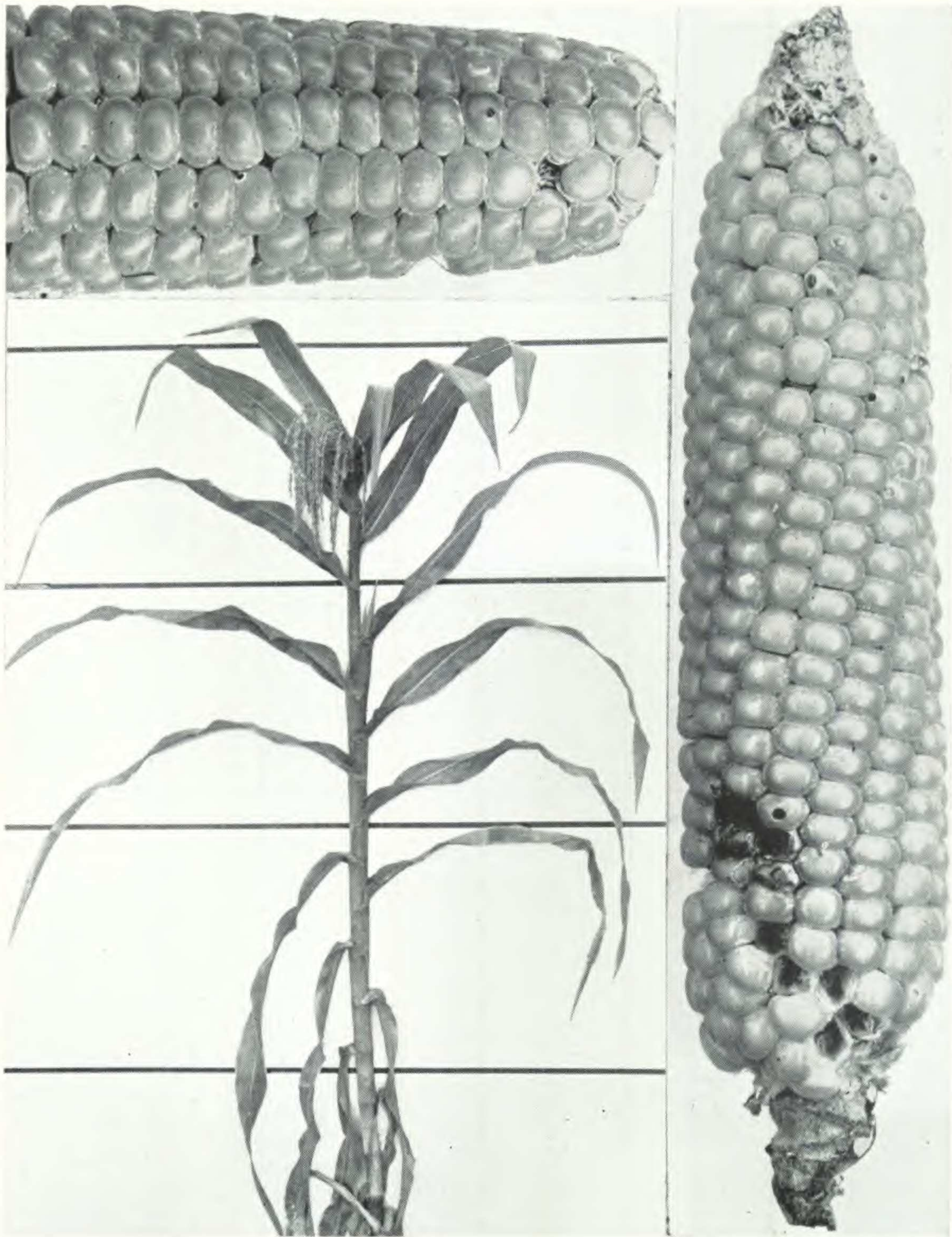


STONOR & ANDERSON—MAIZE OF ASSAM

EXPLANATION OF PLATE

PLATE 21

Lower left: habit of Stonor No. 16 (Drooping Waxy). Scale indicated by the lines in the background, originally spaced at 50 cms. Note clustering of upper leaves due to short internodes. Tassel had been shedding for some time and was nearly mature when the photograph was taken. Photograph courtesy of California Institute of Technology. Right: ear of Stonor No. 18 (Late Sidewise). Approximately natural size. Above: portion of ear No. 13, approximately natural size. Photographs of ears, courtesy of Royal Botanic Gardens, Kew, England.



STONOR & ANDERSON—MAIZE OF ASSAM

EXPLANATION OF PLATE

PLATE 22

Ears and plates of Late Upright and Early Upright. Upper left (with stone background), photograph of Stonor No. 8, taken in Shillong, Assam. Note erect and ribbed leaves, still slightly twisted, and that ears scarcely extend from the axils of the leaves. Center above: Stonor No. 5, photographed at a slightly later stage just as the silks were beginning to wither and after all the pollen had been shed. Note that tassel is not completely exerted from upper leaves and that mature ears scarcely exceed their subtending sheaths. Center below, tassel of same plant with its uppermost leaf. Upper right: Stonor No. 6, habit just as tassel was beginning to shed pollen. Note tassel practically hidden by the upper leaves, which are twisted, upright, and ribbed. Scale in this and previous two figures indicated by lines which were originally spaced at 50 cms. Photographs courtesy of the California Institute of Technology. Lower right: ear of Stonor No. 8; lower left: ear of Stonor No. 6, both a little less than natural size. These two ears are almost identical with the popcorns found in early prehistoric graves in coastal Peru (Paracas, Cañete, etc.). Photographs of ears courtesy of Royal Botanic Gardens, Kew, England.